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An Army Intelligence Document

SINO - SOVIET BLOC MISSILE AND SPACE TECHNOLOGY

MAY 1965

Army Missile Command

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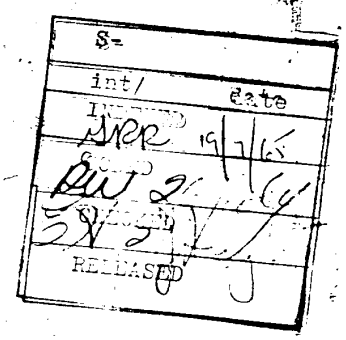

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An Army Intelligence Document

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MS 5 -65

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FOREWORD

MS 5-65 is a summary of developments in the Sino-Soviet Bloc missile and space technology. Intelligence available as of 31 May 1965 was utilized in the preparation of this report.

Comments or queries concerning the material contained in this report should be sent to the Commanding General, U. S. Army Missile Command, ATTN: Directorate of Missile Intelligence, Redstone Arsenal, Alabama.

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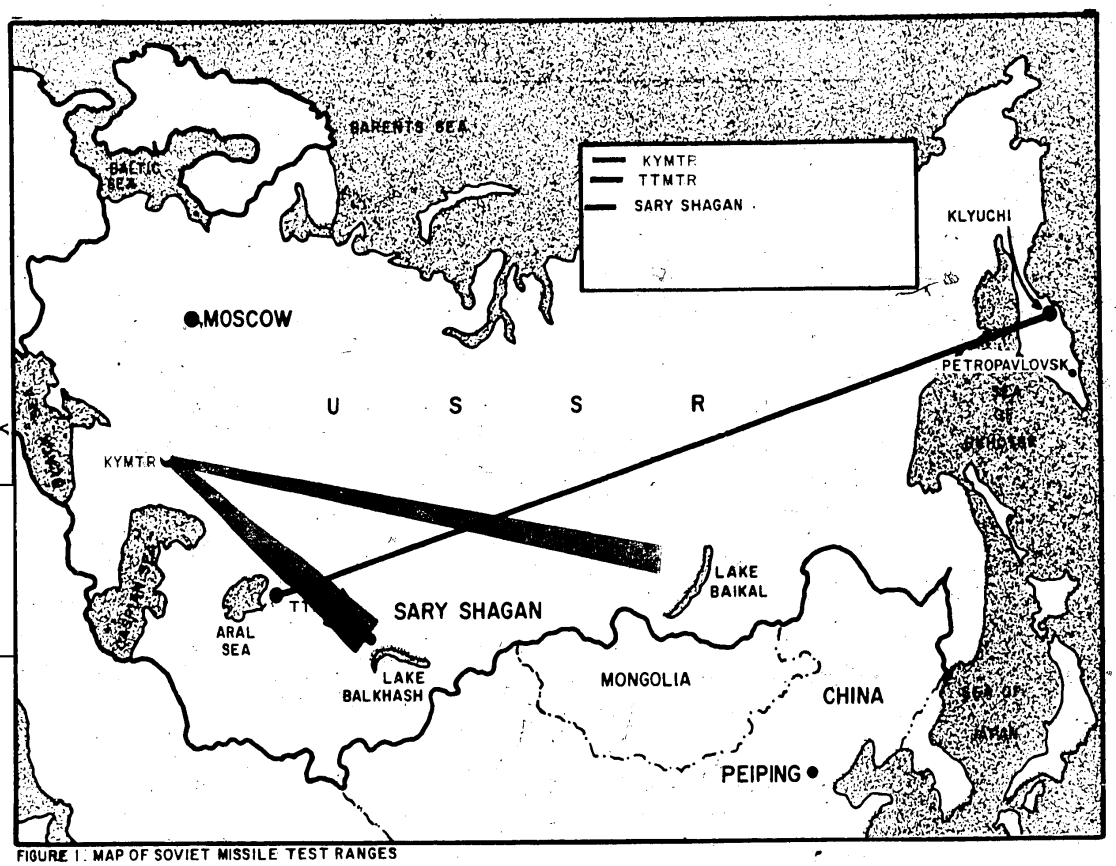

FIGURE 1. MAP OF SOVIET MISSILE TEST RANGES

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SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
						1
2	3	4 TTMTR: ICBM failure.	5	6	7 TTMTR: COSMOS 66 launched. KYMTR: SS-1 launch to 150 nm.	8 KYMTR: SS-1 launch to 150 nm.
9 TTMTR: Luna-5 launched.	10	11	12 KYMTR: SS-4 launch to 1050 nm.	13	14 KYMTR: SS-1 launch to 150 nm.	15 KYMTR: SS-1 launch to 150 nm.
16	17	18 TTMTR: SS-9 launch to KAMCHATKA.	19 TTMTR: ICBM failure. NORFLT: Launch of a probable SS-N-4.	20 TTMTR: ICBM failure.	21	22 TTMTR: SS-7 launch to KAMCHATKA.
23 30	24 31 NORFLT: Launch of a probable SS-N-4. NORFLT: Launch at a possible SS-N-4.	25 NORFLT: Launch of a possible SS-N-4 KYMTR: SS-3 launch to 650 nm. TTMTR: COSMOS 67 launched.	26 NORFLT: Launch of a probable SS-N-4 KYMTR: SS-3 launch to 650 nm. KY-2 launch to 458 nm.	27	28 TTMTR: SS-7 launch to KAMCHATKA. ICBM failure.	29

FIGURE 2. CALENDAR OF EVENTS.

I. SUMMARY

The Soviets recently released a TV film showing firings of defensive missiles such as the SA-1 and SA-2 antiaircraft missiles, the antiaircraft system of the KYNDA class ship, the GRIFFON and GALOSH antimissile missiles, and one new system whose role other than defensive has not been firmly identified. No significant new information has been derived from the antiaircraft missile coverage, but the film did provide more information on the AMM's as well as the newly identified system.

A third antiarmor missile system, which is similar in concept to the SNAPPER and SWATTER systems, was displayed for the first time in the Moscow Parade of 9 May 1965. The basic carrier was a modified 4 x 4 amphibious armored reconnaissance vehicle (BRDM) that carried six antitank missiles on a single-post launcher mechanism.

ICBM launch activity included three firings - two SS-7's and one SS-9 - to the Kamchatka impact area; six additional operations resulted in cancellations or failures. Although there is tenuous evidence that some of these operations involved either SS-8 or SS-9 missiles, the rather large number of cancellations and failures noted this year suggests that a new missile(s) may be under test.

An SS-4 missile was launched from the Kapustin Yar Missile Test Range (KYMTR) on 12 May and, according to RADINT, impacted in the 1050 nm area.

Two probable SS-3 missiles were successfully launched to the 650 nm impact area, one each on 25 and 26 May, and were probably conducted for crew training.

Communication groups between rangehead and the 150 nm area of the KYMTR were active on 15 occasions during May, but only five periods of activity resulted in identified launches: two probable launches that were likely routine crew training firings and three confirmed launches of a vehicle instrumented with 76 mc/48 - channel telemetry.

A KY-2 missile was fired to about 458 nm downrange in what appeared to be a reduced research and development test on 26 May. The communication participants in this operation were located at rangehead and in the general impact area; only one telemetry system was intercepted.

The Soviets launched two photo-reconnaissance satellites and one lunar probe vehicle during May. Both satellites were deorbited and apparently recovered, but the lunar probe was not a complete success since this vehicle apparently made a hard impact on the moon, its announced mission being a soft landing.

Soviet naval missile activity was limited to three probable and two possible ballistic missile launchings in the Northern Fleet area. All of these operations were probably for routine crew training. In each operation the missile was launched from the Ostrov Kildin area along the Murman Coast line-of-fire to the Chizha impact area, a distance of 275 nm. The three probable launchings are believed to have involved SS-N-4 missiles from G class submarines; the two possible launches probably also involved SS-N-4 missiles, but this cannot be established.

Three new missiles were displayed in the Moscow Parade of 9 May 1965: a two-stage solid propellant missile, nicknamed SCAMP; a three-stage liquid propellant ICBM, nicknamed SCRAG; and a three-stage solid ICBM, nicknamed SAVAGE. It is felt that the SCAMP probably has an MRBM capability, but would require a propulsion system equal to the best U. S. system and a small payload (1000 pounds or less) to achieve the 2150 nm range claimed by the Commander in Chief of the Soviet Rocket Forces. The SCRAG has an intercontinental and/or earth orbit capability; a preliminary analysis indicates that it could be either the SS-8, SS-10 or a new space vehicle. The SAVAGE, if it is an ICBM, would indicate that Soviet solid propellant technology is comparable to that of the U. S. It employs either a composite or a composite modified double-base solid propellant, has an I_{sp} of at least 260 seconds, and can deliver an 800 pound RV to 5700 nm.

Because of increased Chinese security measures, there has been a loss in the identities of some advanced-weapons-related aircraft in west China. Increased [redacted]

25X9

II. DEFENSIVE MISSILE SYSTEMS

A. Antimissile Missile Systems

1. Current Activity

No operational activity was observed on the Sary Shagan Antimissile Test Center (SSATC) during May. The 06S and 16S communications groups have not been heard in even routine communications since 26 and 29 April 1965, respectively. One SS-4 was launched from Kapustin Yar to the 1050 nm impact area during the month (Table 1), but there is no evidence of SSATC interest in the operation. Figure 3 is a compilation of all SSATC - related activity.

2. Analysis of Soviet TV Film

Recently, the Soviets released a TV film entitled "Soviet Rockets For Peace" which showed some of their military capabilities in the missile field. The film provided coverage of firings of defensive missiles, including SA-1 and SA-2 antiaircraft missiles, the antiaircraft system on the KYNDA class ship, GRIFFON and GALOSH antimissile missiles, and one new system whose role other than defensive has not been firmly identified. No significant new information has been derived from the antiaircraft missiles; however, the film did provide more information on the AMM's as well as a newly identified system (paragraph c). Several items of electronics associated with surface-to-air and AMM systems were shown. These included the probable HEN ROOST antenna seen at Sary Shagan in April 1960, and probable HEN EGG/HEN NEST sites as well as two new radars. A complete analysis of all the electronics will be made after receipt of stills and scalings of the film.

a. GALOSH Firing

The GALOSH missile as seen in the video tape is of a two-stage tandem configuration and employs four clustered solid rocket motors similar to the GRIFFON booster for the first stage propulsion system. The overall length of the booster section appears to be slightly longer than the previously estimated 15 feet; the second stage propulsion system has not been positively determined but could possibly be solid. The aerodynamic configuration of the missile differs slightly from the configuration derived from the analysis of the Moscow parade photography, the main difference being in the apparent configuration of the sustainer stage. The second stage configuration appears to be of conical shape rather than a cone-cylinder-frustrum section. This conical shape would eliminate the use of fins and/or a frustrum section that would otherwise be required for second stage stability, thus reducing the drag and any thermal dynamic heating problems on the leading edges of the fins.

The four booster fold-out fins are used in conjunction with the aerodynamic shaping of the second stage for stabilizing the vehicle during the boost phase; these fins are of a clipped-delta planform and are actuator controlled. The video clip indicates that the fins are actuated simultaneously upon clearing the launch tube and that they have a rather high rate of rotation.

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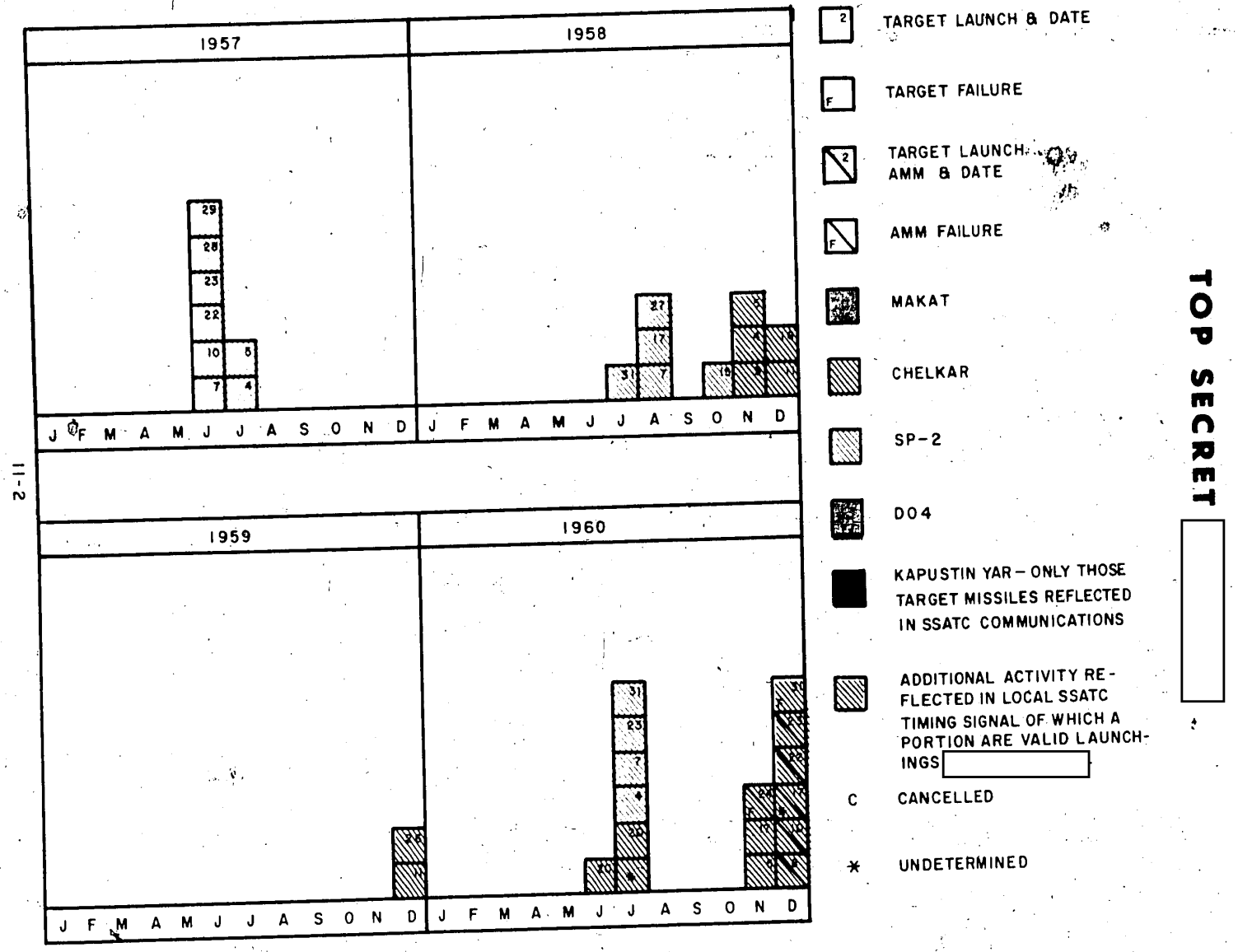

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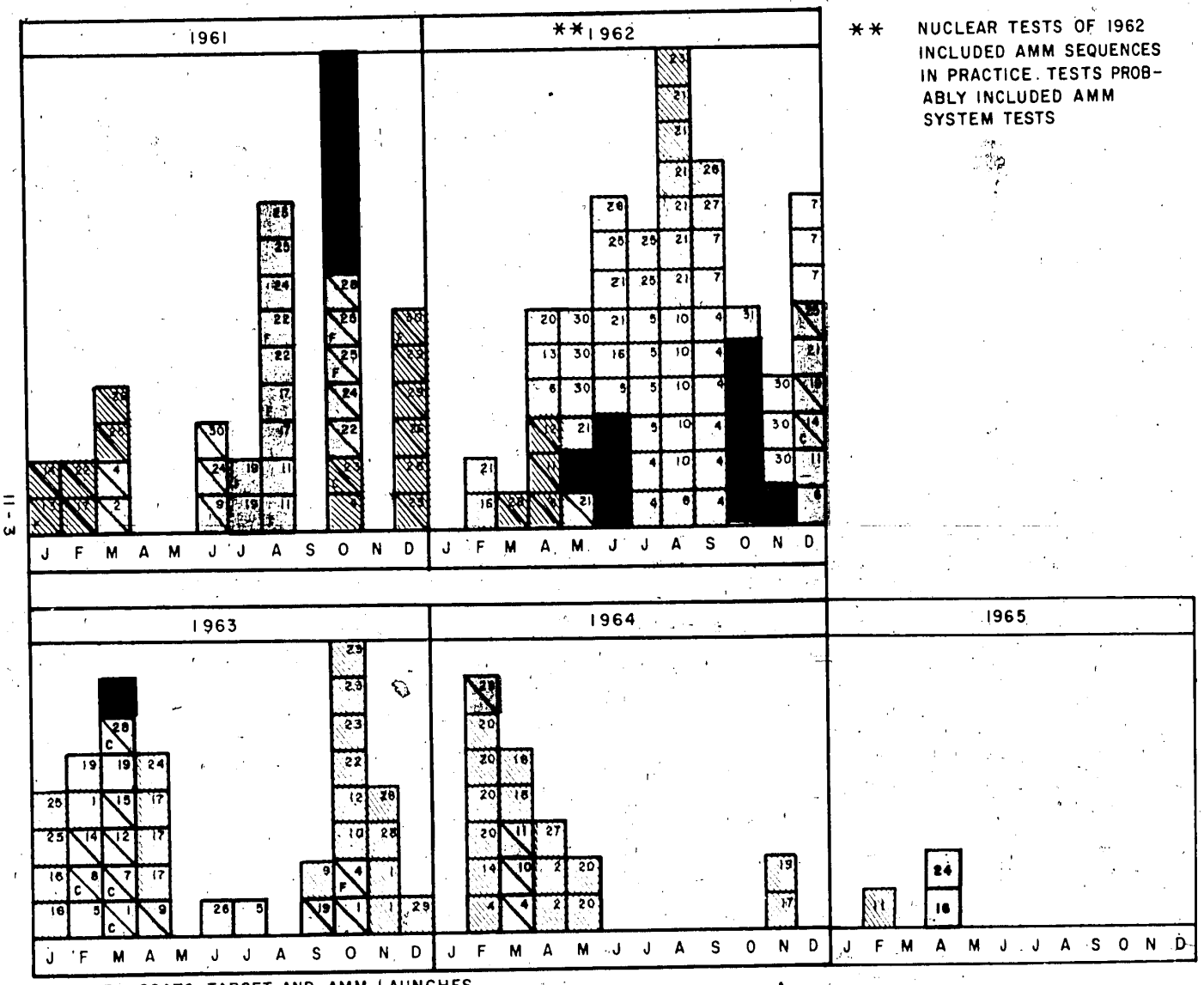

** NUCLEAR TESTS OF 1962 INCLUDED AMM SEQUENCES IN PRACTICE. TESTS PROBABLY INCLUDED AMM SYSTEM TESTS

FIGURE 3. SSATC TARGET AND AMM LAUNCHES

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TABLE 1. TABULATION OF SSATC PARTICIPATION IN FIRINGS

Launch Point		Kapustin* Yar	Kapustin* Yar	Makat SP-12	Chelkar SP-5	SP-2	D04B
Missile		8K65	8K63	8K63	8K51	8Zh38	-
Range (Approx)		1050	1050	780	517	275	
YEAR	QTR						
1957	3rd					8	
	4th						
1958	1st						
	2nd						
	3rd					4	
	4th				5	1	
1959	1st		1				
	2nd		6				
	3rd		3				
	4th		4		2		
1960	1st		5				
	2nd	2	3		1		
	3rd		18		2	4	
	4th	2	9		9(5)		
1961	1st	2	10	2(2)	6(5)		
	2nd		10	3(3)			
	3rd		10				11
	4th		19(5)		8(5)		5(5)
1962	1st		6		1(1)		
	2nd		19(3)		3(3)	1(1)	
	3rd		9				
	4th	3	22	6(2)			
1963	1st		7	9(3)			
	2nd		7	2(1)			
	3rd		13	2(1)			
	4th		13	2(1)			
1964	1st		11	4(4)			
	2nd		3				
	3rd		13				
	4th		8				
1965	1st		2				
	2nd		1	2**			
	3rd						
	4th		2				
TOTAL		9	234(8)	32(17)	37(19)	18(1)	16(5)

*After January 1961 there is no way to determine the participation of SSATC since the communications link had been deactivated. All firings to the area have been included since that time.
( ) Numbers in parentheses indicate possible intercept attempts.

**No SSATC communications intercepted.

The TV film suggests that the missile is fired from the container at a launch angle of about 70°. Lift-off acceleration is estimated to be less than 20 g's. Although some differences in configuration were observed, it is still estimated that the burnout velocity is in the 10,000-11,000 fps category. However, burnout altitude could be lowered substantially, depending upon the propulsion system.

b. GRIFFON Firing

The GRIFFON was probably launched from the northern area of Complex A at Shary Shagan. The film confirms the previously estimated launching and role for the GRIFFON. A study of the film indicates a variable launch angle as opposed to the estimated near vertical launch. Information on the trajectory will be published as soon as possible. The film showed the movement of the GRIFFON from the bay building to the launcher with the missile positioned on the underside of the rail. The launcher pivoted the missile away from the bay and the rail rose to the firing position. Immediately after launch the GRIFFON rolled 45° indicating a control system similar to that used in the SA-2 system. This confirms the use of sustainer fin aileron roll control. A slightly longer booster burn time was noted. In the film the long nose probe is evident with the protective cover being removed.

c. Newly Identified Defensive Missile

A missile which was not previously identified was shown in the final active sequence of the video clip. This missile appeared to be of a general SA-2 GUIDELINE configuration; that is, it had cruciform sustainer fins, rear control fins and booster fins. Although scalings are not available, a general impression is that the missile fineness ratio is smaller than that of the GUIDELINE. Another feature is the lack of any trailing edge sweep angle on the sustainer fins, which were of a clipped delta planform similar to those of the GRIFFON missile. The booster fins, however, appeared to be of a rectangular planform. The missile was fired from an SA-2 type launcher and appeared to have a boost acceleration slightly higher than the GUIDELINE missile. The commentary accompanying the new missile sequence refers to defense against aircraft, winged missiles, and ballistic missiles; therefore, the specific role(s) for the new missile cannot presently be determined.

A newly identified three-dish radar was shown in the firing sequence of the new missile. If, as implied in the film, the new radar is a part of the system, it is probable that this is a new system rather than a modification of an existing system. The three-dish radar is composed of two large dishes and a smaller dish. One of the large dishes has a feed like the SCR 584 with a conical scanner, but the other feed is not readily identifiable. The two large dishes may be used in a [redacted] and the smaller dish could be used for a command function. This radar was not actively involved in either of the firing sequences; however, the film sequence and the appearance of the missile and radar in the same frames imply that it is a part of the system.

25X9

d. Electronics

(1) Spherical Gimbaled Radome: One electronic item was a large spherical, gimbaled radome with two flat surfaces protruding from the lower part of the sphere which turned in one plane with the sphere. From initial analysis of this structure, it is estimated that this radome is a monopulse tracking radar with compensation included for wind loads on the sphere.

Monopulse is estimated because of the four waveguide runs that appear at two different locations on the structure. One run of four waveguides is on top of the base leading to the cradle which supports the sphere, and the second is visible leading into the sphere from the cradles.

The two large flat surfaces attached at the lower part of the sphere are believed to be employed to compensate for the wind loads on the sphere in the plane perpendicular to the flat surfaces.

Since dimensions are not available at this time, an estimate of the frequency or other parameters cannot be made.

Monopulse or simultaneous lobing has advantages over other types of tracking such as conical or sequential lobing. In conical or sequential lobing tracking, several pulses without amplitude-modulation are required to accurately determine target position. However, with a monopulse tracking radar only one pulse is required to determine the angular position of the target.

(2) Naval SAM Guidance: Based upon PEEL group antenna analysis, the GOA missiles associated with the KYNDA class ship are thought to utilize a command guidance link. If these missiles are identical to those observed in the Moscow Parade photographs, then command rather than beam rider guidance is also believed to be used with the LOW BLOW fire control radar. However, analysis is continuing in an effort to determine the guidance link used with the LOW BLOW.

B. Antiarmor Missile Systems

A third antiarmor missile system, nicknamed SAGGER, was displayed for the first time by the Soviets in the 9 May 1965 Moscow parade. The system concept appeared to be basically the same as that of the SNAPPER and SWATTER systems.

The basic carrier was a modified 4 x 4 amphibious armored reconnaissance vehicle (BRDM) which has a road speed of 40 mph and a cruising range of 200 miles. Four supplementary wheels that are mounted under the vehicle, two in tandem on each side, can be raised or lowered hydraulically to assist in traversing trenches and adverse terrain. A hydrojet water-borne propulsion system is also provided. Maximum speed for this mode of operation is about 5-6 knots per hour.

Each of the vehicles carried a total of six new antitank missiles mounted on top of their launch rails and supported by a single-post launcher mechanism (Figure 4). Three missiles are mounted on each side of the centerpost in a triangular-shaped launch configuration (one on top and two on the bottom). Located directly above the clustered package is a roof-type cover which also serves as the cover for the rear compartment of the vehicle in the travel position.

25X1D

A preliminary analysis indicates that the new antitank missile
25X1D has an overall length of about [ ] and a maximum diameter of about [ ]. The missile consists of a spherically tipped conical nose shape and a cylindrical afterbody at the rear of which are mounted cruciform fins of an unusual shape. The fins appear to be similar in shape to those on the SWATTER and to be hinged on the outboard portion toward the vertical plane of the missile. However, aerodynamic control surfaces could not be determined from the limited photography.

The guidance mode is unknown, but it may be a radio guided system similar to that of the SWATTER system since an optical-type sighting device (similar to one on the SWATTER launch vehicle) was observed on the forward portion of the cab.

Preliminary analysis indicated that the missile weighs 15-20 pounds and has a maximum range capability of about 1000 meters.

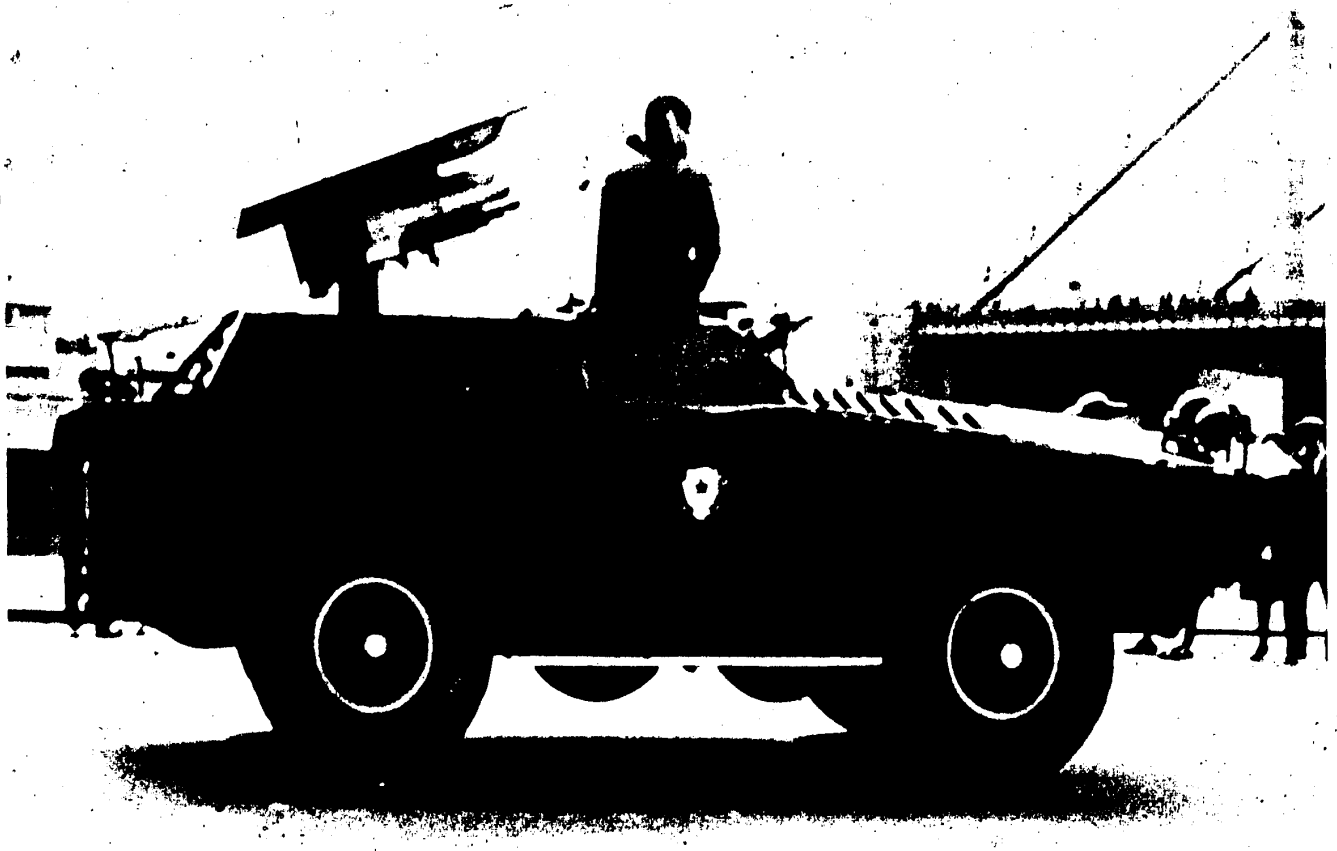

FIGURE 4. NEW ANTIARMOR MISSILE SYSTEM, SAGGER, MOSCOW PARADE, 9 MAY 1965

III. OFFENSIVE MISSILE SYSTEMS

A. Intercontinental Ballistic Missile Systems

Current Activity

The Soviets displayed two new ICBM's in the 9 May Moscow parade. An assessment of these vehicles is presented in annexes to this report.

Two SS-7's and one SS-9 were successfully fired to the Kamchatka impact area, and six additional operations resulted in either cancellations or failures. There is tenuous evidence that some of the operations may have involved either SS-8 or SS-9 missiles, but the rather large number of cancellations and failures noted thus far this year suggests that a new missile(s) may be under test. An unidentified but successful firing on 19 April may have been one of a new series. There have been no SS-10 launchings noted since 20 October 1964. Table 2 is a chronology of ICBM launch activity.

1. ICBM Failure, 4 May

An operation from the Tyuratam Missile Test Range (TTMTR) on 4 May probably ended in an early in-flight failure. A full sequence was noted on the range timing signal, indicating that launch occurred at approximately 0505Z; however, negative [redacted] and telemetry intercepts indicate that the vehicle failed early in flight. This event is designated an ICBM rather than a space operation because of the lack of participation by space-associated activities; the type missile involved is not known.

2. Probable ICBM Cancellation, 8 May

Communications activity indicated that an ICBM firing was scheduled on the TTMTR for approximately 0530Z, 8 May but was apparently cancelled before 0630Z. The continuation of timing signal intercepts beyond the apparent intended launch time suggests there were delays in the countdown. There is insufficient data to determine the type missile involved in the operation.

3. Probable ICBM Cancellation, 14 May

[redacted] indicated that a probable ICBM operation directed to the Kamchatka impact area was cancelled in the late stages of the countdown on 14 May. Launch was probably intended for about 1030Z. The type vehicle involved is not known.

4. Successful SS-9 Launch, 18 May

An SS-9 ICBM was launched on the TTMTR to the Kamchatka impact area at approximately 0500Z, 18 May. Its successful flight was confirmed by telemetry intercepts, radar sightings, and visual observation of the re-entry. Extensive instrumentation and FLIM FLAM participation indicate that this firing was a continuation of the SS-9 R&D program. Considering that there have now been at least 21 SS-9 firings and a low

TABLE 2. CHRONOLOGY OF ICBM LAUNCH ACTIVITY

DATE	MISSILE	RESULTS
	1957	
21 Aug	SS-6	success
07 Sep	SS-6	success
	1958	
30 Jan	SS-6	success
13 Mar	SS-6	cancelled
22 Mar	SS-6	success
04 Apr	SS-6	success
24 May	SS-6	success
30 Jul	SS-6	cancelled
10 Jul	SS-6	failure
24 Dec	SS-6	failure
	1959	
17 Feb	SS-6	success
21 Feb	SS-6	cancelled
25 Mar	SS-6	success
30 Mar	SS-6	failure
30 May	SS-6	success
16 May	SS-6	cancelled
30 May	SS-6	success
09 Jun	SS-6	success
18 Jul	SS-6	success
30 Jul	SS-6	success
13 Aug	SS-6	success
18 Sep	SS-6	success
22 Oct	SS-6	success
25 Oct	SS-6	success
30 Oct	SS-6	cancelled
31 Oct	SS-6	cancelled
01 Nov	SS-6	success
20 Nov	SS-6	success
27 Nov	SS-6	success
21 Dec	SS-6	success
22 Dec	SS-6	cancelled
23 Dec	SS-6	success
	1960	
19 Jan	SS-6	cancelled
20 Jan	SS-6	success
24 Jan	SS-6	failure
29 Jan	SS-6	cancelled
31 Jan	SS-6	success
17 Mar	SS-6	success
24 Mar	SS-6	success
03 Jun	SS-6	cancelled
04 Jun	SS-6	success
05 Jul	SS-6	success
07 Jul	SS-6	success
23 Oct	SS-7	cancelled
24 Oct	SS-7	cancelled
	1961	
14 Jan	SS-6	success
02 Feb	SS-7	failure
13 Feb	SS-6	success
27 Feb	SS-6	success
03 Mar	SS-7	failure
02 Apr	SS-7	success
09 Apr	SS-8	failure
14 Apr	SS-6	failure
15 Apr	SS-7	success
18 Apr	SS-8	cancelled
19 Apr	SS-8	cancelled
21 Apr	SS-8	success
21 Apr	SS-7	failure
25 Apr	SS-8	failure
16 May	SS-7	success
24 May	SS-7	failure
27 May	SS-8	cancelled
29 May	SS-8	success
02 Jun	SS-8	failure
02 Jun	SS-7	success
06 Jun	SS-7	failure
15 Jun	SS-6	success
15 Jun	SS-7	cancelled
16 Jun	SS-7	unresolved
04 Jul	SS-6	success
04 Jul	SS-6	success
22 Jul	SS-7	failure
24 Jul	SS-8	cancelled
25 Jul	SS-8	success
28 Jul	SS-8	cancelled
29 Jul	SS-8	cancelled
30 Jul	SS-8	cancelled
30 Jul	SS-8	success
03 Aug	SS-8	unresolved
08 Aug	SS-7	cancelled
09 Aug	SS-7	success
12 Aug	SS-7	cancelled
13 Aug	SS-7	success
02 Sep	SS-7	cancelled
03 Sep	SS-7	cancelled
03 Sep	SS-7	cancelled
04 Sep	SS-7	success
08 Sep	SS-8	cancelled
09 Sep	SS-8	cancelled
09 Sep	SS-7	success
10 Sep	SS-8	cancelled
10 Sep	SS-8	failure
13 Sep	SS-7	success
17 Sep	SS-7	success
18 Sep	SS-8	cancelled
19 Sep	SS-8	failure
20 Sep	SS-6	cancelled
21 Sep	SS-6	success
21 Sep	SS-7	cancelled
22 Sep	SS-7	failure
26 Sep	SS-8	success
06 Oct	SS-8	success
08 Oct	SS-8	failure
09 Oct	SS-7	cancelled
09 Oct	SS-7	success
11 Oct	SS-7	failure
12 Oct	SS-8	success
14 Oct	SS-8	cancelled
15 Oct	SS-7	success
22 Oct	SS-7	success
28 Oct	SS-7	success
27 Nov	SS-6	cancelled
28 Nov	SS-7	cancelled
29 Nov	SS-6	success
29 Nov	SS-7	success
01 Dec	SS-7	failure
	1962	
03 Jan	SS-7	cancelled
04 Jan	SS-7	success
12 Jan	SS-7	success
16 Jan	SS-7	success
17 Jan	SS-7	success
25 Jan	SS-7	success
03 Mar	SS-7	success
20 Mar	SS-8	failure
22 Mar	SS-8	success
18 Apr	SS-8	success
20 Apr	SS-8	failure
23 Apr	SS-8	success
01 Jun	SS-7	success
07 Jun	SS-7	cancelled
07 Jun	SS-7	success
07 Jun	SS-8	cancelled
08 Jun	SS-8	cancelled
09 Jun	SS-8	success
11 Jun	SS-8	cancelled
14 Jun	SS-8	success
18 Jun	SS-8	cancelled
19 Jun	SS-8	success
21 Jun	SS-8	success
22 Jun	(SS-8)	failure
27 Jun	SS-8	failure
02 Jul	SS-6	success
13 Jul	SS-8	failure
21 Jul	SS-7	success
21 Jul	SS-8	cancelled
21 Jul	SS-8	success
24 Jul	SS-8	success
28 Jul	SS-8	cancelled
29 Jul	SS-8	failure
31 Jul	SS-7	success
07 Aug	SS-7	cancelled
08 Aug	SS-7	cancelled
08 Aug	SS-7	success
27 Sep	SS-7	success
05 Oct	SS-7	success
05 Oct	SS-7	success
11 Oct	SS-7	success
11 Oct	SS-7	cancelled
11 Oct	SS-7	success
16 Oct	SS-7	success
17 Oct	SS-7	success
02 Nov	SS-7	success
03 Nov	SS-7	success
03 Nov	SS-7	cancelled
04 Nov	SS-7	success
25 Nov	SS-7	success
12 Dec	SS-7	success
13 Dec	SS-7	success
19 Dec	SS-7	success
	1963	
11 Feb	SS-8	success
14 Feb	SS-8	cancelled
22 Feb	SS-8	success
04 Mar	SS-7	success
11 Mar	SS-8	failure
14 Mar	SS-8	success
30 Mar	SS-7	success
22 Apr	SS-6	success
26 Apr	SS-7	success
18 May	SS-6	success
18 May	SS-7	success
18 May	SS-7	(cancelled)
18 May	SS-7	success
20 May	SS-8	success
25 May	SS-7	success
01 Jun	SS-7	success
20 Jun	(SS-7)	cancelled
21 Jun	(SS-7)	failure
28 Jun	SS-7	success
30 Jun	SS-7	success
03 Jul	Unk	(cancelled)
08 Jul	SS-7	success
09 Jul	SS-7	success
24 Jul	Unk	failure
27 Jul	SS-7	success
13 Aug	SS-7	success
20 Aug	SS-7	success
30 Aug	SS-7	success
04 Sep	SS-7	cancelled
04 Sep	SS-7	success
10 Sep	SS-7	success
11 Sep	SS-8	cancelled
12 Sep	SS-8	success
17 Sep	SS-8	success
24 Sep	Unk	cancelled
26 Sep	SS-7	success
27 Sep	SS-6	success
28 Sep	Unk	cancelled
01 Oct	SS-7	success
14 Oct	SS-6	success
18 Oct	SS-8	failure
22 Oct	Unk	success
03 Oct	SS-7	success
05 Nov	SS-8	success
05 Nov	Unk	unresolved
06 Nov	Unk	cancelled
22 Nov	SS-7	success
03 Dec	SS-8	success
04 Dec	(SS-7)	cancelled
08 Dec	(SS-7)	failure
12 Dec	SS-7	success
13 Dec	(SS-8)	cancelled
20 Dec	SS-7	success
21 Dec	SS-8	success
25 Dec	SS-8	success
29 Dec	(SS-8)	cancelled
	1964	
04 Jan	SS-8	success
09 Jan	SS-8	success
12 Jan	SS-8	success
16 Jan	SS-8	success
22 Jan	SS-8	success
22 Jan	SS-8	failure
24 Jan	SS-8	success
25 Jan	SS-8	success
02 Feb	SS-8	success
02 Feb	SS-7	success
06 Feb	SS-7	success
19 Feb	SS-9	success
26 Feb	SS-7	failure
27 Feb	Unk	(cancelled)
03 Apr	SS-7	success
11 Apr	SS-10	failure
14 Apr*	(SS-7)	success
21 Apr	Unk	failure
29 Apr	Unk	cancelled
14 May	Unk	cancelled
15 May	SS-10	success
15 May	SS-8	success
23 May	SS-9	success
30 May	SS-9	success
30 May	SS-10	success
30 May	SS-7	success
03 Jun	SS-6	success
17 Jun	SS-10	success
23 Jun	Unk	cancelled
24 Jun	SS-9	success
26 Jun	Unk	cancelled
30 Jun	SS-9	success
27 Jul	SS-6	success
21 Jul	(SS-9)	success
01 Aug	SS-10	success
05 Aug	SS-9	success
11 Aug	SS-9	failure
09 Sep	SS-9	success
10 Sep	SS-7	success
24 Sep	SS-10	success
24 Sep	SS-6	success
25 Sep	SS-9	success
25 Sep	SS-7	success
25 Sep	SS-7	success
02 Oct	SS-10	success
10 Oct	SS-9	success
20 Oct	SS-10	success
23 Oct	Unk	failure
29 Oct	SS-9	success
23 Nov	Unk	failure
16 Dec	SS-9	success
18 Dec	SS-7	success
26 Dec	SS-7	success
	1965	
13 Jan	(SS-5)	failure
30 Jan	SS-9	success
05 Feb	Unk	failure/ cancelled
13 Feb	Unk	(failure)
26 Feb	SS-7	success
04 Mar	SS-8	success
06 Mar	SS-8	success
10 Mar	SS-7	success
30 Mar	SS-7	success
3 Apr	Unk	cancelled (failure)
12 Apr	SS-7	success
17 Apr	Unk	cancelled
19 Apr	Unk	cancelled
1 Apr	SS-7	success
7 Apr	SS-8	success
28 Apr	SS-7	success
04 May	Unk	failure
09 May	Unk	cancelled
14 May	Unk	cancelled
15 May	SS-9	success
19 May	Unk	failure
22 May	Unk	failure
25 May	SS-7	success
28 May	SS-7	success
28 May	Unk	failure

*Launched from a point other than Tyuratam.

failure rate, some version of the system must be almost operational at this time.

5. ICBM Failure, 19 May

An ICBM firing directed to the Kamchatka impact area probably resulted in an early in-flight failure on 19 May. A full launch sequence that was noted on the range timing signal indicated X-ray at approximately 0620Z, but the lack of [redacted] and telemetry indicates an early failure which may have been partially due to high winds in the launch area. The type missile fired is not known.

6. ICBM Failure, 20 May

An ICBM operation on the TTMTR on 20 May probably ended in an early in-flight failure. [redacted] indicated that launch occurred shortly before 0345Z, but the lack of radar sightings and telemetry that can definitely be associated with the firing indicates an early failure. A 165 mc carrier signal, which has recently been restricted to the SS-9 and the unidentified vehicle fired on 19 April, was intercepted from 0345:10Z to 0347:56Z and has been tentatively associated with the operation. The flight bans reported for this operation were consistent with those reported for SS-6, SS-8, and SS-10 launchings, but FLIM FLAM participation indicates that the vehicle was most likely an SS-10. Therefore, it appears that the missile involved in this operation was either an SS-10 or one of the new type launched on 19 April.

7. Successful SS-7 Launch, 22 May

An SS-7 ICBM was successfully launched on the TTMTR to the Kamchatka impact area at approximately 0629Z, 22 May. FLIM FLAM and [redacted] data reveal that the vehicle flew the high trajectory for the SS-7 (apogee 497 nm). No re-entry vehicle telemetry was intercepted, indicating that the firing was for troop training purposes.

8. Successful SS-7 Launch, 28 May

An SS-7 ICBM was successfully launched to the Kamchatka impact area at approximately 0223Z on 28 May; the vehicle flew the low trajectory for the SS-7 (apogee 401 nm). The absence of re-entry vehicle telemetry indicates that this firing, like the previous one, was for troop training purposes.

9. ICBM Failure, 28 May

A second operation on the TTMTR on 28 May probably ended in an early in-flight failure. A launch sequence on the range timing signal indicated launch at approximately 0515Z, the failure being indicated by negative [redacted] and telemetry. An unidentified signal on 165 mc was intercepted by a mid-east facility from 0359:13Z to 0409:25Z and, if related to this operation, would have been on-pad telemetry. The flight ban in effect for the operation suggests either an SS-7 or SS-9 firing; the 165 mc signal, if related, could indicate either an SS-9 or a new missile.

B. IRBM/MRBM Systems

1. 2200 nm Ballistic Missile System (SS-5)

There were no SS-5 missile firings noted on the Kapustin Yar Missile Test Range (KYMTR) during the month of May. There have been four SS-5 launches this year (three in January and one in March).

SS-5 firings for 1965 appear to be following the same pattern noted for 1964. In 1964 there were SS-5 firings during the first quarter but no firings in April or May; in 1965 there were firings during the first quarter and, as in 1964, no firings in April or May. Although the significance of this particular pattern is not known, it may represent some minor modification testing concerned with improving the overall performance of the system; however, the main emphasis is probably on training/production line tests.

2. 1020 nm Ballistic Missile System (SS-4)

On 12 May an SS-4 was launched at approximately 1230Z on the KYMTR and, according to [redacted] impacted in the 1050 nm area. The vehicle was instrumented with a 65 mc/24-channel telemetry system. Although a range timing signal was not intercepted, communications groups at rangehead (K01) and Aral'sk (K12) were active; however, there is no evidence to indicate that this activity was associated with the launch. None of the other downrange communications groups were noted active.

The last noted SS-4 launches occurred on 16 and 24 April and were probably fired from Makat to the 1050 nm area. The two firings in April were probably conducted for the AMM program, and it is believed that the missiles were launched by SS-4 crews brought to the range from deployed sites.

Sixteen SS-4 launches were identified during the first five months of 1964, but only five launches have been noted this year - two in March, two in April, and one in May - which is less than a third of those noted in 1964. This reduction in firings is not considered unusual for the following reasons:

The first SS-4 units were deployed in late 1958 or early 1959; consequently, this system has been operational for at least 6 or 7 years. However, there will be some crews brought from deployed sites to Kapustin Yar for service practice tests.

The Soviets have probably corrected any deficiencies noted in this weapons system during the 6-7 year operational period.

Series production of the SS-4 began in 1958 and probably terminated in late 1962, and the production line models were probably tested in 1963 and 1964.

There was a reduction this year in the number of SS-4 missiles fired in conjunction with the AMM program.

Based upon this, it is expected that the number of SS-4 firings would decrease.

3. 650 nm Ballistic Missile System (SS-3)

Two probable SS-3 missiles were launched to the 650 nm impact area, one each on 25 and 26 May. This was the second pair of SS-3 launchings noted this year, the first pair occurring in April. [redacted] indicated that both missiles successfully impacted in the 650 nm area, the launches probably being conducted for crew training. No [redacted] or operational communication activity was noted; however, activity by communication groups in the K01, K10, K11 and K12 areas was noted, but was apparently not related to these launches.

Recent information indicates that a probable SS-3 launch occurred on 26 April in addition to the two reported on 22 and 24 April. According to a preliminary [redacted] report, the missile was detected in beams 6 through 10 from 1418:19 to 1420:51Z which is comparible with [redacted] reports for missiles fired to 650 nm. There was also an [redacted] report of a missile launch from Kapustin Yar at 1413Z and of a re-entry in the 650 nm impact area which further substantiates a third probable SS-3 launch in April.

X1

X1

C. Short Range Ballistic Missile Systems

Communication groups between rangehead and the 150 nm area of the KYMTR were active on 15 occasions during May, but only five periods of activity resulted in identified launches. Two probable launches, one at 0725:02Z on 7 May and another at 1047:02Z on 8 May, were likely routine firings for crew training.

Launches at 1912Z on 14 May, at 0800Z on 15 May and at 0907Z on 18 May are considered, on the basis of criteria published in MS 4-65, to be confirmed firings. In each operation, the vehicle was instrumented with a 76 mc/48-channel telemetry system.

The remaining ten operations terminated with indeterminate results on the following dates:

Date	Period of Activity	Date	Period of Activity
06 May	1023-1310Z	17 May	1058-1350Z
11 May	1111-1435Z	18 May	0730-0958Z
12 May	0431-0735Z	19 May	0559-0910Z
13 May	1629-1847Z	20 May	0745-1056Z
14 May	0558-0905Z	25 May	0815-1111Z

TABLE 3. KY-2 MISSILE SYSTEM TEST ACTIVITY

NR	DATE	TIME	RESULTS	COUNTDOWN	FREQ/CHFR	UP	DOWN	ACQ	DUR	BEAMS	RANGE	APOGEE	VELOCITY OF APOGEE	NUMBER OF OBJECTS	COMMUNICATIONS	REMARKS
1	1974 05 Feb	0501:17	Failure	0412-0615											K01,K08,K11	Acoustint fix at Kapustin Yar.
2	11 Feb	(1201)	Failure	1108-1237											K01,K08,K11	Acoustint fix at Kapustin Yar.
3	16 Mar	1412:54	Success	0745-1443	76/48 66/40 136/20 2800/hcn	133 133 143 150	318 297 310 316				(300)				K01,K02,K03, K04,K05/06, K08,K11	
4	08 Apr	(0841:35)	Success	0734-0855	76/48 66/48 136/20 2800/hcn	108 185 255 309	432 450 276 475	163	203	4,5,8, 9,10	460	150	6022	3	K01,K08,K11	Lofted Trajectory
5	25 Apr	0605:26	Failure	0508-0624	-	-	-	-	-	-	-	-	-	-	K01,K02,K03, K05/06,K08,K11	Failed shortly after launch.
--	16 Jul	-	Cancelled	0036-0012	-	-	-	-	-	-	-	-	-	-	K01,K08,K10	Cancelled at about 0012Z.
	17 Jul	-	Cancelled	0621-0746	-	-	-	-	-	-	-	-	-	-	K01,K08,K10	Cancelled at about 0746Z.
6	18 Jul	0430:23	Success	0254-0440	76/48	108	149	219	111	6,7,8,9	510	135	7408	3	K01,K05/06,K08, K10	
	04 Aug	-	Unknown	1815-1853	-	-	-	-	-	-	-	-	-	-	K01,K08,K11	Possibly associated with KY-2 program.
	11 Aug	-	Unknown	1136-1454	-	-	-	-	-	-	-	-	-	-	K01,K08,K10	
7	12 Aug	0300:12	Success	0132-0450	66/48 76/48 136/20	150 100 430 138	166 170 454 151	201	78	6,7,8	515	133	7935	1	K01,K05/06, K08,K10	76/48 telemetry switched off during mid-flight.
8	02 Sep	(1745)	Failure	1557-1745	66/48 76/48	(81) (81)	(96) (96)	-	-	-	-	-	-	-	K01,K05/K06, K08,K10	Probably early in-flight failure.
9	10 Oct	0700:04	Success	0616-0734	76/48 2805/hcn	[illegible] 438 106	[illegible] 422 483	176	[illegible]	5-10	481	137	-	5	K01,K05/K06, K08,K10	76/48 telemetry switched off during mid-flight.
10	16 Oct	(1210)	Success	1111-1439	76/48	(109)	(112)	(173)	180	5-10	507	137	-	5	K01,K08,K10	Part of demonstration involving SS-1, SS-3, SS-4, SS-1 and KY-2 systems.
11	29 Oct	1215:02	Success	1050-1511	76/48 136/20 2800/hcn	105 101 101	115 107 357	171	153	5-9	480	134	-	6	K01,K05/K06, K08,K10	
12	28 Nov	1114:26	Success	0943-1431	76/48 2800/hcn	122 123	311 296	-	-	-	(300)	-	-	-	K01,K05/K06, K08,K10	[redacted]
13	21 Dec	0944:59	Success	0711-1116	76/48	132 200	134 311	-	-	-	(300)	-	-	-	K01,K08,K10	[redacted]
14	1975 15 Jan	1500:03	Success	1332-1622	76/48 2800/hcn	306 119	312 317	-	-	-	(300)	-	-	-	K01,K08,K10	[redacted]
15	30 Jan	(0515)	Success	0345-0515	76/48 2800/hcn	117 [illegible]	169 [illegible]	207	76	5,6	300	111	-	4	K01,K08,K10,K11	Lofted Trajectory.
16	10 Feb	1200:06	Success	1054-1417	76/48 2800/hcn	133 145	454 454	-	-	-	(300)	-	-	-	K01,K08,K10	
17	20 Feb	0530:02	Failure	0529-0801	-	-	-	-	-	-	-	-	-	-	K01,K08,K10	Failed shortly after launch.
18	05 Mar	1100:21	Success	0926-1306	76/48 136/Unk 2810/hcn	81 124 423 115 123	89 137 437 131 433	212	123	5	300	115	-	-	K01,K08,K10	Lofted Trajectory.
19	13 Mar	0830:21	Success	0659-1133	76/48 136/Unk 2800/hcn	114 118 107	121 120 436	176	132	4,5,6	312	112	-	2	K01,K08,K10, (K05/K06) (K11), (K12)	Lofted Trajectory.
20	24 Apr	1000:29	Success	0830-1140	76/48 2800/hcn	119 [illegible]	152 [illegible]	211	93	[illegible]	[illegible]	[illegible]	-	-	K01, K08, K10	Lofted Trajectory.
21	26 May	(1730)	Success	1636-1738	76/48	(182)	(514)	(210)	(150)	5-9	418	125		8	K01, K11	

There is no firm evidence to suggest firings on any of these dates; however, it is felt that a large portion of this activity does represent actual SS-1 launches for crew training.

Cumulative operations involving the 150 nm area since 25 January 1965 are as follows: 4 confirmed firings, 8 probable firings, 1 possible firing, and 23 undetermined operations.

D. KY-2 Missile System

A KY-2 missile was fired to about 458 nm downrange at approximately 1730Z on 26 May; its altitude at apogee was 125 nm (Table 3). Communications stations located at rangehead (K01) and Makat (K11) conducted this operation. Communication stations at Aral'sk (K12) and the Moscow-Emba link were also active, but there is no evidence to indicate that they participated in the launch. The vehicle was tracked by U. S. radar from 1733:38Z to 1736:15Z; a 76 mc/48-channel telemetry system was intercepted from 1732:22Z to 1738:34Z.

This operation appeared to have been a reduced research and development test (R-R&D) since the communication participants were located only at rangehead and in the general impact area, and only one telemetry system was intercepted. The only aspect of this operation which would not suggest an R-R&D test was the fact that the telemetry apparently functioned throughout the flight instead of being switched off following separation. This was the first KY-2 firing in which stations located in the 150 nm impact area (K08, K10) did not participate and the first since 29 October 1964 to a range greater than 300 nm.

There have now been 21 launches of the KY-2 missiles; 16 successes and 5 failures. It appears that the launch on 26 May was the second R-R&D operation; the first possible test of this type occurred on 24 April 1965 (20th test). Although the 20th and 21st launches appear to have been R-R&D tests, they cannot be definitely identified as such at this time.

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V. NAVAL MISSILE SYSTEMS

A. Current Activity

Soviet naval missile activity was limited to three probable and two possible ballistic missile launchings in the Northern Fleet area. All of these launchings were probably for routine crew training. In each operation the missile was launched from the Ostrov Kildin area along the Murman Coast line-of-fire to the Chizha impact area, a distance of 275 nm. The three probable launchings are believed to have involved SS-N-4 missiles from G class submarines; the two possible launches probably also involved SS-N-4 missiles, but this cannot be established.

B. Northern Fleet Missile Activity

On 19 May, at approximately 1300Z, a probable SS-N-4 missile was launched in the area of 70°N, 35°E (near Ostrov Kildin) toward Chizha, utilizing a platform that is believed to have been G class submarine pendant number 170. Post-fire reports were received from Chizha at 1336Z, 1404Z and 1435Z.

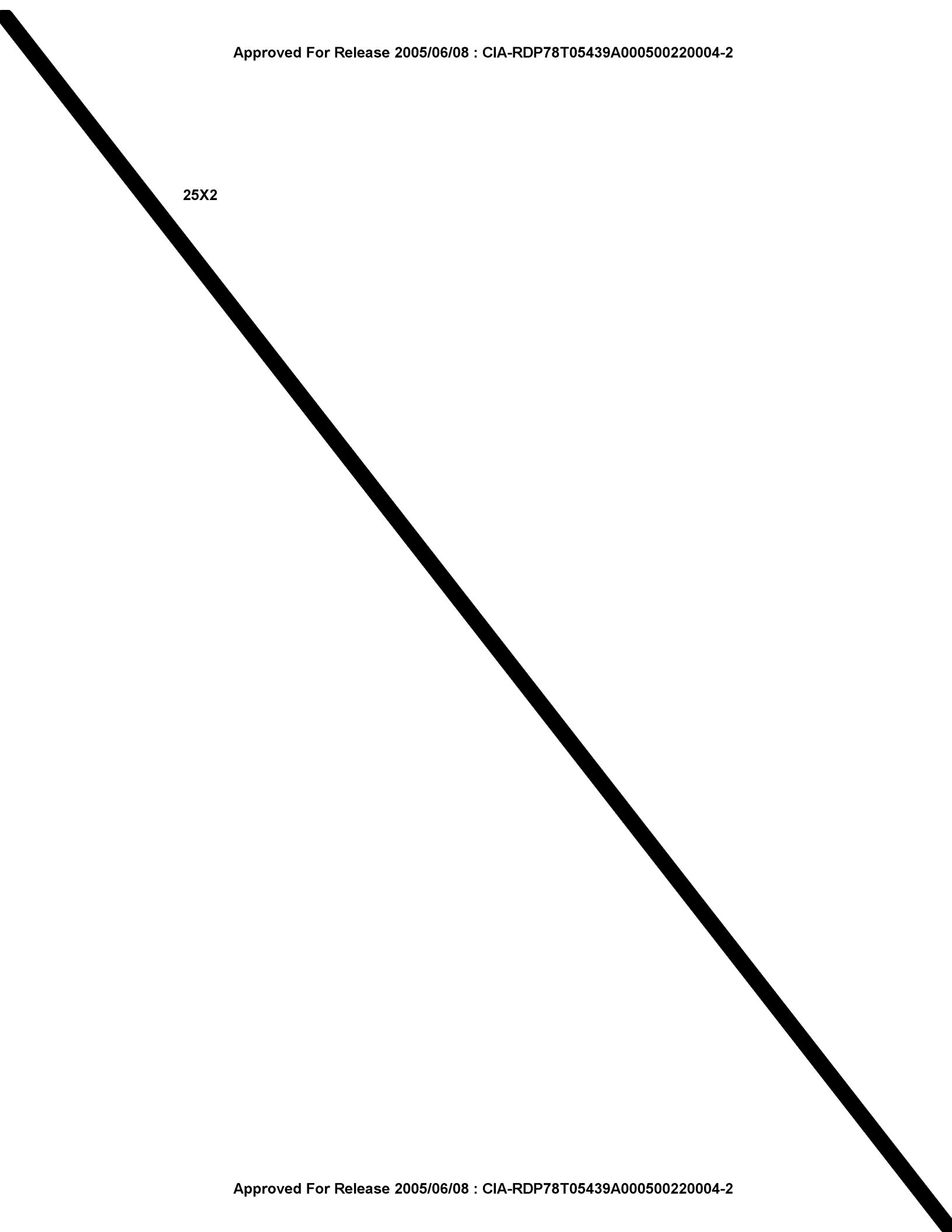
G class submarine pendant number 162 is believed to have been the launch platform for the next probable SS-N-4 launch which occurred at 1000Z on 24 May. One possible post-fire report was received from Chizha at 1020Z.

A possible SS-N-4 missile was launched at 1300Z on 25 May, but the launch-platform could not be identified; post-fire reports were received from Chizha at 1314Z and 1321Z.

G class submarine pendant number 170 is believed to have been the launch platform for a probable SS-N-4 launch that occurred at 1336Z on 26 May. Post-fire reports were received from Chizha at 1344Z and 1354Z.

A possible SS-N-4 was launched from an unidentified platform at 1330Z on 31 May. A message from Chizha at 1413Z may have been a post-fire report.

25X2



ANNEX A. IRON' MAIDEN MISSILE SYSTEM DISPLAYED IN MOSCOW PARADE (9 MAY 1965)

1. Possible Technical Characteristics of IRON MAIDEN (SCAMP)

This study on the possible technical characteristics of the IRON MAIDEN is based on the largest configuration that will fit in the container and should therefore provide the maximum performance of this missile. The configuration in this study includes missile diameters taken from SARK tankage and is the first of a series of configurations to be investigated before a final estimate of this missile can be made. An attempt to determine if a smaller missile is a more likely design will be considered in a later study, based on the diameters of the SERB tankage and the second and third stage tankage of the three stage solid (SAVAGE). (Figures 5 and 6)

CONCLUSIONS

a. The IRON MAIDEN is a two-stage solid propellant missile with a second stage that is smaller in diameter than the first stage.

b. The IRON MAIDEN probably has an MRBM capability.

c. With a range of 2150 nm, as claimed by the CINC of the Soviet Rocket Forces, the IRON MAIDEN would require a propulsion system equal to the best U.S. systems and a small - 1000 lbs or less - payload.

d. If the IRON MAIDEN is the KY-2 (550 nm system), the Soviet solid propellant technology is either noticeably inferior to U.S. technology, or a very large payload is employed.

The most probable diameters for the IRON MAIDEN appear to be those derived for the SARK (5.41/4.59 ft), the SERB (4.92/4.1 ft) and the THREE STAGE SOLID (4.85/3.30 ft). The scalings for the SARK, which were obtained from photographs of that missile during previous Moscow parades, were used as the basis of this study. Since these values are important factors in evaluating a missile, the latest available scalings were selected. Should these scalings be changed by a later analysis, a re-examination of this configuration may be necessary.

The external configuration of the IRON MAIDEN container indicates that the missile is a stepped-stage design, the missile interstage conical section probably being very near the change in cross section of the container.

It has been argued that a missile using the SARK tankage diameters would be very crowded in the pod and that the SERB diameters would allow more room. The SERB diameters (4.92/4.10 ft) are not inconsistent with the observed portion of the SCAMP which is 5.58 ft in diameter since the rear section of the SCAMP is flared. (Figure 7)

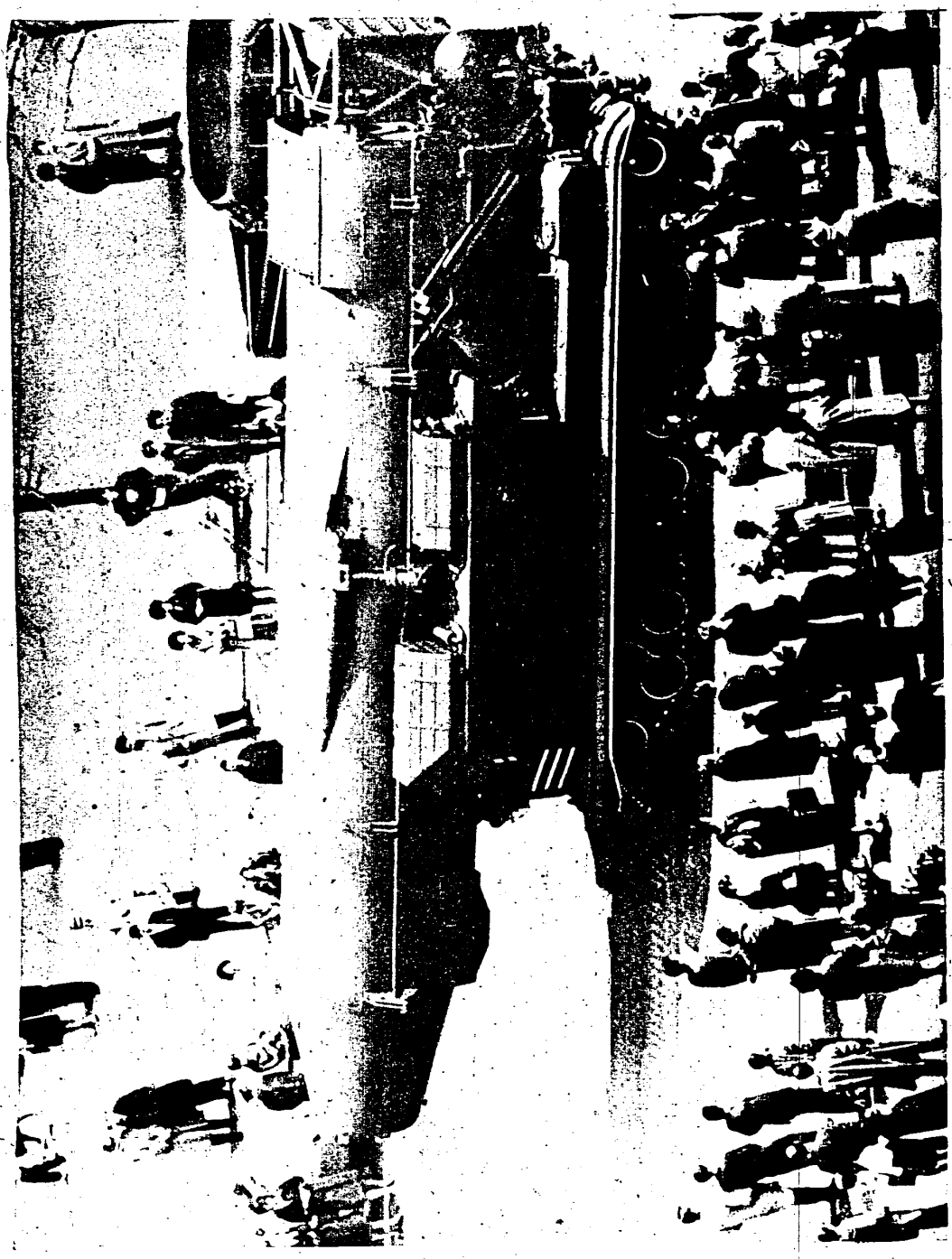


FIGURE 5. IRBM MAIDEN (SCAMP) MISSILE SYSTEM, 9 MAY 1955

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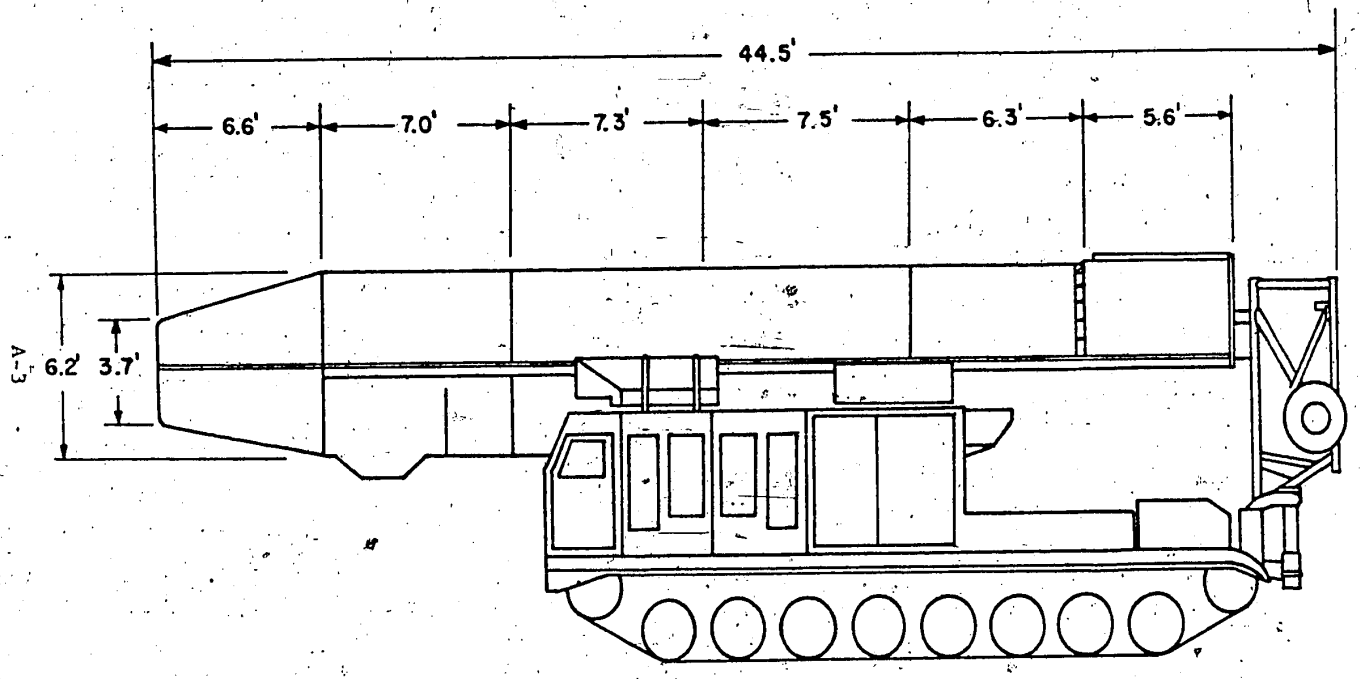

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FIGURE 6. PRELIMINARY LINE DRAWING OF SCAMP MISSILE SYSTEM TRANSPORTER AND MISSILE CONTAINER

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*Based on largest missile which could fit in the missile container.

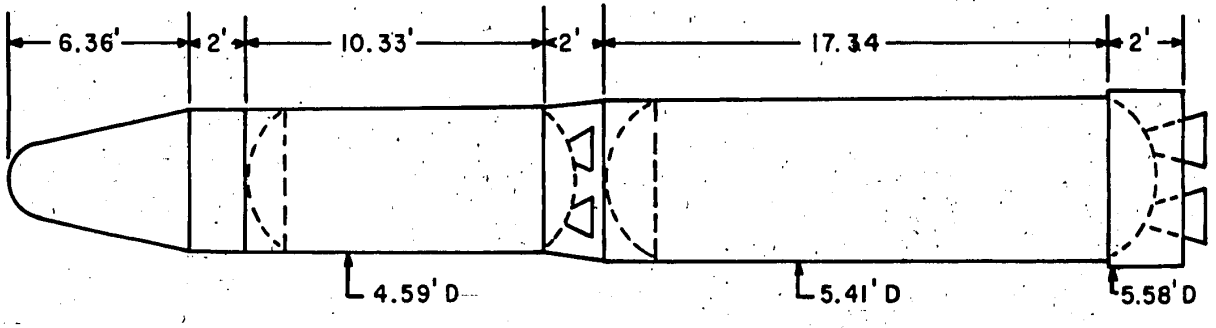

FIGURE 7. PRELIMINARY CONFIGURATION ESTIMATE OF SCAMP MISSILE.*

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There are two strong indicators that the IRON MAIDEN is a solid propellant missile: the container which is probably for environmental control, and the nozzle design. The container may indicate that the IRON MAIDEN motor has a high propellant packing fraction (PPF, ratio of propellant volume to container volume). The PPF does not have a large effect on range, but it does have an effect on the temperature limits a motor can tolerate, motors with a PPF above .80 being more sensitive to temperature changes and more likely to crack (Figure 8). Since increasing the PPF from .80 to .85 would increase the range only slightly, it seems unlikely that a high PPF would be the only reason for the container.

The vacuum specific impulse (Isp_V) and the mass fraction (MF, ratio of propellant weight to total motor weight) are important considerations in determining missile range (Figure 9). If the technology of the THREE STAGE SOLID (which, from the study in ANNEX C, has an Isp_V) of at least 260 seconds (Figure 10) applies to the IRON MAIDEN, then this missile would definitely be an MRBM

However, should the IRON MAIDEN use the technology of the SERB, its range would be much less: the SERB is presently estimated to have an Isp_V of 260 seconds and a range of 1100 nm, but the lack of proof that it has ever been fired to this range creates some doubt as to the validity of this assumption. If the IRON MAIDEN uses the technology of the SERB, whose range may be only 650 nm, its range would be that of an SRBM with a payload capability greater than that of the SERB. On the other hand, if Soviet technology has advanced further that in the U. S., then the IRON MAIDEN could be an IRBM as claimed with a reasonable RV weight.

It must be remembered that this study is based on the maximum size missile that will fit into the container and may be negated in part by studies of possible smaller missile configurations. The full range possibilities are shown in Table 5.

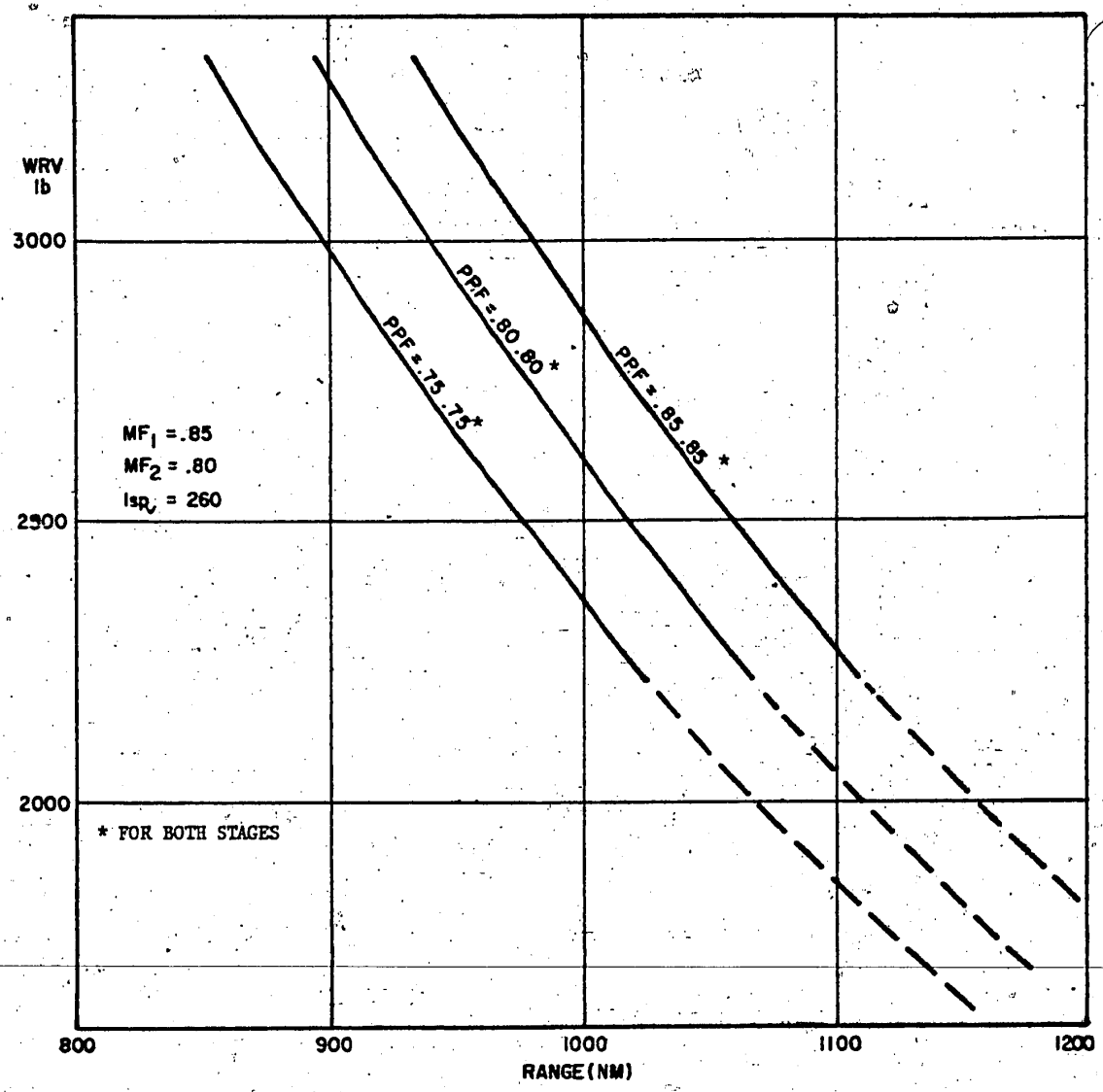
2. Transporter-Erector-Launcher (TEL)

a. General Description

The basic chassis used for this vehicle appears to be quite similar to the one used for the Soviet 310 mm self-propelled gun and the 420 mm self-propelled mortar. The TEL is equipped with eight road or track wheels on torsion bar suspension and has the same drive sprocket at the rear as the gun carriage; however, the TEL has five track return rollers where only four were used on the gun carriages. The drive sprocket and the idler sprocket both appear to have been raised on the TEL to provide a better angle of departure and approach.

The TEL, although large and heavy, presents relatively clean lines with all externally stowed gear either recessed or under contoured covers. The entire vehicle appears to provide good protection to both missile and crew from overhanging tree limbs or brush, flying debris, weather, and

FIGURE 8. PARAMETRIC STUDY OF PROPELLANT PACKING FRACTION (PPF) vs RE-ENTRY VEHICLE WEIGHT (WRV) AND RANGE FOR THE SCAMP MISSILE.



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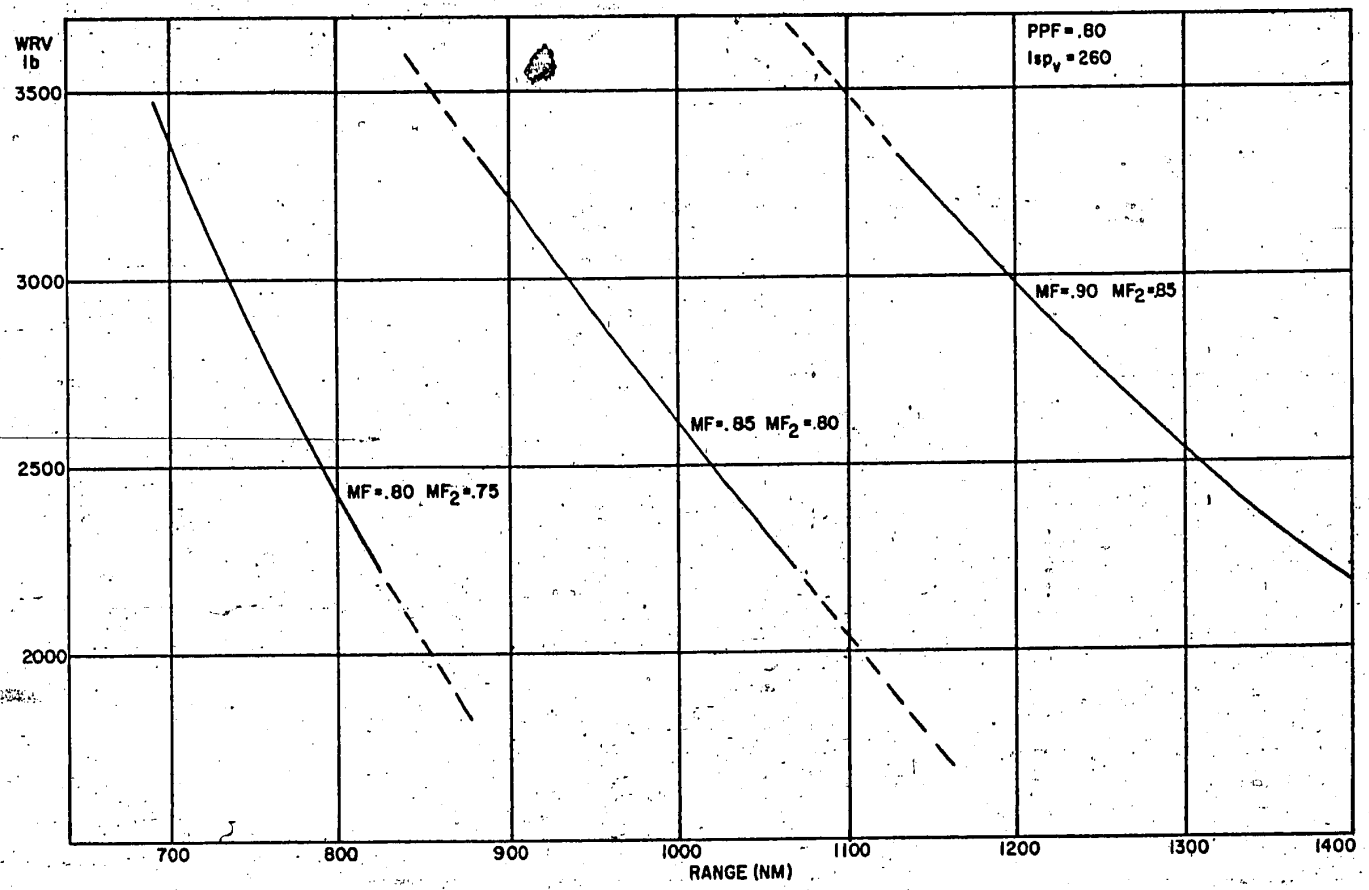

FIGURE 9. PARAMETRIC STUDY OF MASS FRACTION vs RE-ENTRY VEHICLE WEIGHT (Wrv) AND RANGE FOR THE SCAMP MISSILE

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FIGURE 10. PARAMETRIC STUDY OF VACUUM SPECIFIC IMPULSE vs RE-ENTRY VEHICLE WEIGHT (WRV) AND RANGE FOR THE SCAMP MISSILE.

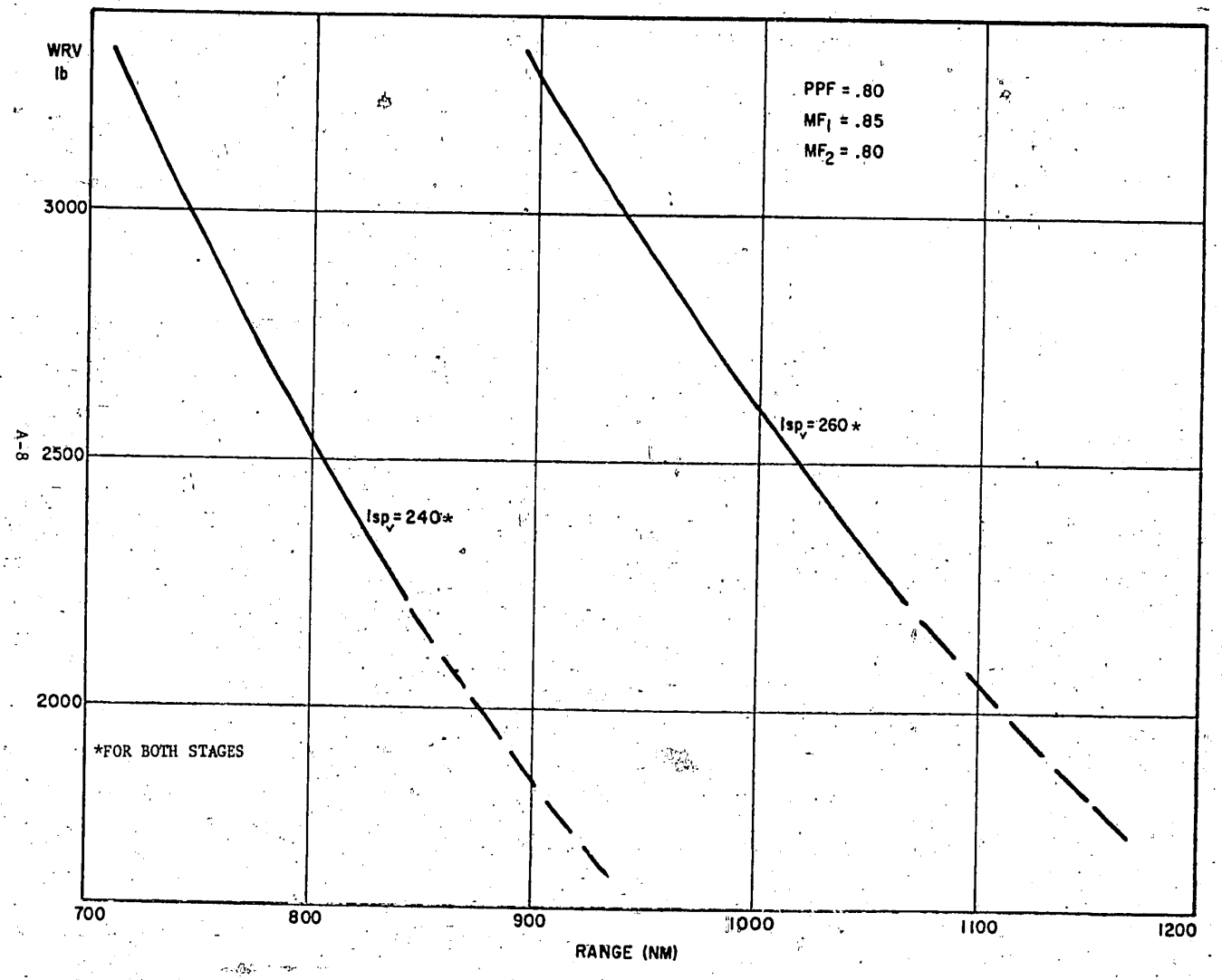

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TABLE 5. SCAMP MISSILE CONFIGURATION

	SRBM	MRBM	IRBM
Relation to U. S. technology	Inferior	Similar	Superior
Range (nm)	530	975	2150
Liftoff Weight (lbs)	60,480	60,080	59,660
RV Weight (lbs)	3320	2770	2220
$I_{s_{Pv_1}}$ (sec)	240	260	280
$I_{s_{Pv_2}}$ (sec)	240	260	300
PPF_1	.75	.80	.85
PPF_2	.75	.80	.85
MF_1	.80	.85	.90
MF_2	.75	.80	.85

to some limited extent from small arms fire or shell fragments; however, the missile container appears to be primarily designed for controlled environmental protection. Although the aft end of the container was open when displayed in the parade, there appears to be provision for including a protective cover. Inclusion of an aft cover and the presence of the two louvered panels in the container cover, that are possible breathers, strongly indicate that this is a pressurized container.

b. Operational Features

The sequence of the erection operation is as follows:

(1) The ground pads for the vehicle stabilizer jacks, which are stowed during travel on each side of the launching table, are placed on the ground beneath the two jacks on the aft end of the vehicle.

(2) The stabilizer jacks are apparently screw-type jacks that are actuated by hydraulic motors. When they are lowered to mate with the ground pads, they remove the spring action from the torsion bar suspension to stabilize the chassis during missile erection and firing.

(3) The launching table with integral blast deflector is lowered by the hydraulic cylinder, which is located in the center of the aft end of the chassis, until the ends of the bottom side members mate with the pads on the aft end of the vehicle and the table is leveled in this position cantilevered from the vehicle.

(4) The lock holding the missile container at the forward end of the vehicle is released, apparently by use of the handwheel.

(5) The container with the missile is raised to the vertical position with the two hydraulic cylinders located on either side of the container, and the pads on the base of the missile are mated with those on the launching table.

(6) The hydraulically operated locks on the right side and forward end of the container are released, and the hydraulic cylinder on the left side opens the container.

(7) The container is lowered and closed, leaving the missile free, standing on the launching table.

c. Conclusions

The missile container on the TEL is designed primarily to provide controlled environmental protection for the missile.

The basic chassis is a proven design, being an adapted modification of previous vehicles.

This TEL can erect and launch the missile without assistance from other items of ground support equipment.

ANNEX B. THE THREE-STAGE LIQUID PROPELLANT ICBM DISPLAYED IN MOSCOW PARADE (9 MAY 1965)

1. Introduction

The Soviets displayed a new missile with an intercontinental and/or earth orbit capability in the 9 May 1965 parade. As a result of preliminary analysis the missile could be either the SS-8, SS-10, or a new space vehicle. The SS-7 and SS-9 were eliminated because of the four nozzles on the first stage of the parade missile, since both of these vehicles are believed to have three engines. Computer performance runs will be made when detailed scalings are available. This missile has been nicknamed SCRAG.

2. Summary of Conclusions

a. The first stage nozzles and the external configurations of the first and second stages indicate that the first two stages use liquid propellants.

b. The third stage, if used for powered flight, would employ either a solid propellant or a liquid which would utilize a toroidal tankage configuration.

c. The construction features of this vehicle are of older-type design.

d. There has been no evidence of this missile being flown as a three-stage ICBM.

e. If this vehicle is one we have observed from ICBM telemetry, then it is probably the SS-10.

f. The transporter shown could not carry the loaded vehicle.

g. The transporter, although it does not conform to the design of previous large-missile transporters, cannot be relegated to the category of being fabricated only for the parade.

3. Discussion

This is a three-stage liquid propellant system with two conduits connecting all three stages. The three stages are interconnected via a truss work of connecting tubes with the interstage areas exposed. The tubes are connected to the stages through fittings attached directly to the skin. The truss-type connection would not be the most efficient method of transmitting the lateral loads of the vehicle. However, in this type vehicle, the lateral load would probably be overshadowed by the longitudinal load. The construction features of this vehicle are more consistent with those of the earlier missiles, notably SS-2, SS-3, and SS-4.

FIGURE 11. THREE-STAGE LIQUID PROPELLANT ICBM (SCRAG) DISPLAYED IN MOSCOW PARADE, 1 MAY 1965

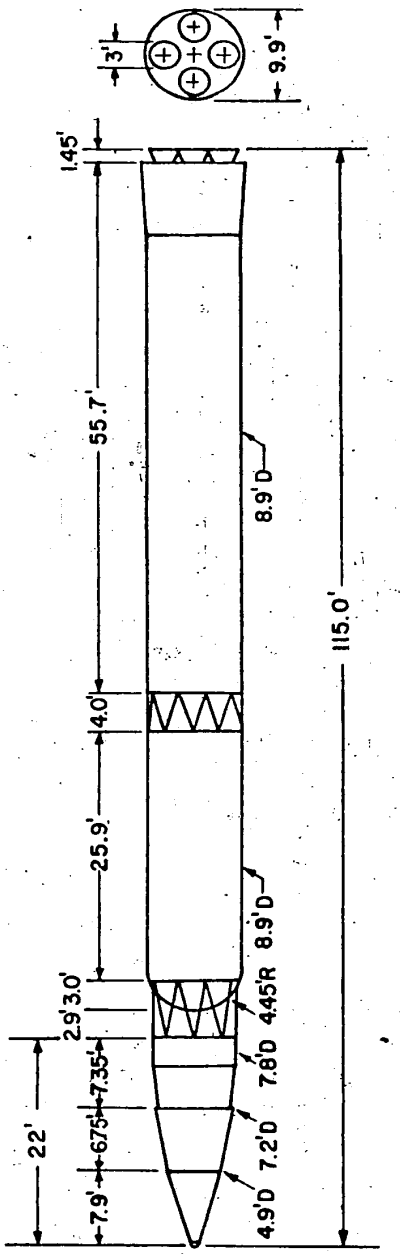

FIGURE 12. LINE DRAWING OF THE SCRAG LIQUID PROPELLANT ICBM.

The missile appears crude with a large number of external hinges and fittings throughout the vehicle. The first and second stages separate at a plane which is approximately at the mid-point of the second stage, leaving the engine compartment and thrust structure exposed. A more detailed analysis must be made before any firm identities can be made concerning the missile. (Figures 11 and 12)

a. First Stage

The first stage appears to utilize single-weld closures for the tank bulkheads of integral tankage or possibly internal tankage. Since there is no readily apparent reason why they would resort to internal tanks, single-weld closures are probably used. It is felt that the Soviets have used double-weld closures on all of the missiles that have been previously displayed. Therefore it would be a change in manufacturing and structural techniques to utilize single-weld closures. The appearance of shallow domes would substantiate the fact that they are not using a "y" ring-type of closure as this would only be structurally sound with approximately √2 bulkheads.

Utilizing dimensions taken from existing photographs, the volumetric ratio would be on the order of 1.7:1. If, indeed, the volumetric ratio is this high, this precludes the more commonly used acid-amine propellants. Some of the exceptions would be RFNA/HYDYNE and RFNA/ANILINE. There are several cryogenic combinations that would fit this ratio, the most probable combination being LOX/RP-1. The stage has access doors in what appears to be an intertank section. The conduits extend into an apparent engine compartment. This section has hinged doors or panels that permit easy access to the engines. There are four symmetrically spaced nozzles, complete with nozzle covers, each with a diameter of 36 inches. There are lines, which might indicate a method of secondary injection, which are attached to the nozzles.

b. Second Stage

The second stage is similar to the first in construction and apparently uses single-weld closures of the integral tank bulkheads. Utilizing rough dimensions taken from existing photographs, the volumetric ratio would be on the order of 1.7:1. This would also accommodate a LOX/RP-1 system. The forward end of the stage has a domed cover latched to the structure. This cover could provide insulation to prevent ice buildup if the forward tank was a LOX tank or the cover could possibly provide heat protection. If the RV (not the third stage in the parade) was attached to the second stage, as would probably be the case if this was an SS-10, then the cover over the dome would not be needed. The stage has access doors at two locations, one could be access to the intertank section, and the other could provide access to the engine compartment. The aft end of the stage is completely covered.

c. Third Stage

The third stage is not the type of body that would be expected as an RV. If this was a three-stage ICBM, the small sphere-cone segment of the third stage is the RV with the payload being 3000-3500 pounds. It is possible this stage could have a single-chamber rocket engine surrounded by toroidal tanks. The third stage appears to have a rather large number of protuberances which are not identified at this time. Panels or doors are available for easy access to the intercompartments. The aft end has a cover which could conceal an engine compartment.

d. ICBM Transporter

This transporter does not conform to the design of previous large-missile transporters, but it cannot be relegated to the category of being fabricated only for the parade because there are too many features that indicate a designed capability to perform functions other than hauling. The transporter may serve as a fixture for mating or horizontal test and checkout and with no evidence to disprove it, even be used in erection.

The main frame of this transporter consists of two longitudinal side beams fabricated primarily from box sections with tubing used for secondary bracing. The beams slope upward from a point approximately one-third of their length back from the forward ends and there is an offset over the rear wheels. The transverse freme members also appear to be built-up box sections with tubing used for diagonal bracing. Tubing is also used for the fabrication of a removable pin-attached guard at the aft end of the transporter.

The transporter running gear consists of a forward, wagon-steered single-axle and an aft single-axle that, in some of the photographs, appears to have a limited degree of steering. Both axles have dual wheels fitted with what appears to be 14.00 x 20 tires which provide a gross weight capability, according to tire tables, of 72,000 pounds at 50 mph or 76,600 pounds at 30 mph.

The vehicle tow bar is an elongated V-type fabricated from channel sections and is heavily reinforced with cross bracing.

The missile is supported on the transporter on two saddles, one just aft of the forward axle and the other just forward of the aft axle. Tie downs consist of a band just forward of the aft saddle and inverted V-ties connected to pins in the missile body directly above the forward saddle.

The transporter is obviously capable of supporting and transporting the missile on a firm level surface in an unfueled condition.

A missile of this size using liquid propellants would not be expected to be moved in a fueled condition nor would it be moved for any appreciable distance even in an empty condition over rough terrain.

ANNEX C. THE THREE-STAGE SOLID PROPELLANT ICBM DISPLAYED IN THE MOSCOW PARADE (9 MAY 1965)

1. Introduction

In the Moscow Parade (9 May 1965) the Soviets displayed a new solid propellant ICBM. The 65-foot missile, designated SAVAGE, is similar in configuration but larger and heavier than the MINUTEMAN missile. (Figures 13 and 14).

a. The SAVAGE is a solid-propellant ICBM capable of delivering an 800-pound re-entry vehicle to a range of 5700 nm.

b. The propellant is probably a double-base or a modified double-base with a vacuum specific impulse of approximately 260 seconds.

c. Due to the problems involved in throttling a solid propellant motor, a new or modified guidance technique must be employed.

d. The CEP is probably no less than 1 nm if the guidance system is inertial and 0.5 to 1 nm if the system is radio guided.

e. The transporter is a well-designed vehicle capable of on-or off-road use. Like the SCRAG (115-foot liquid propelled missile) missile transporter, it lacks some of the design features of previous transporters which are also used as erection beams for their associated missiles, however, its use as an erector cannot be ruled out.

2. Discussion

Since no firing program can be connected with the SAVAGE missile and since the missile uses solid propellants, the usual sizing factors from telemetry (volumetric ratio , f/w, a/a, etc.) could not be used to size the SAVAGE. To do this a parametric study was performed to properly evaluate the missile and its capability.

This study is presented in a series of parametric curves (Figures 15 , 16 , and 17) showing the effect of the independent variables versus range and payload (defined as the weight of the re-entry vehicle and guidance section). The variables considered are as follows:

a. Propellant packing fraction (PPF), the ratio of propellant volume to case volume.

b. Mass fraction (MF), the ratio of propellant weight to motor weight.

c. Vacuum specific impulse (I_{sp}).

FIGURE 13. THE THREE-STAGE SOLID PROPELLANT ICBM (SAVAGE) DISPLAYED IN MOSCOW PARADE, 9 MAY 1965

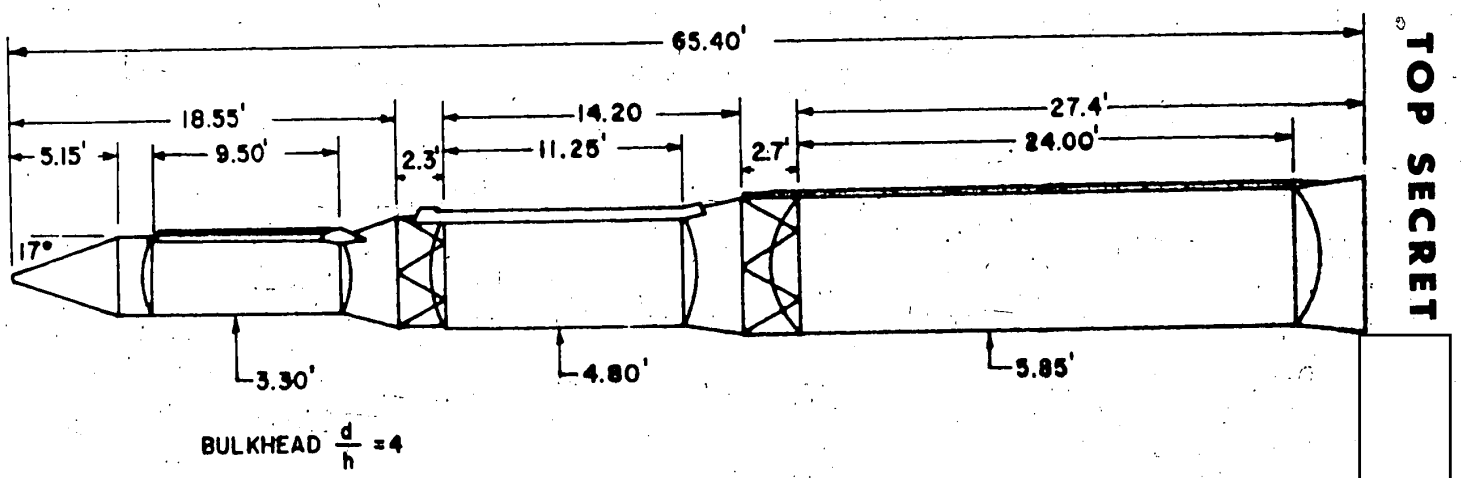

FIGURE 14. LINE DRAWING OF THE SAVAGE SOLID PROPELLANT ICBM.

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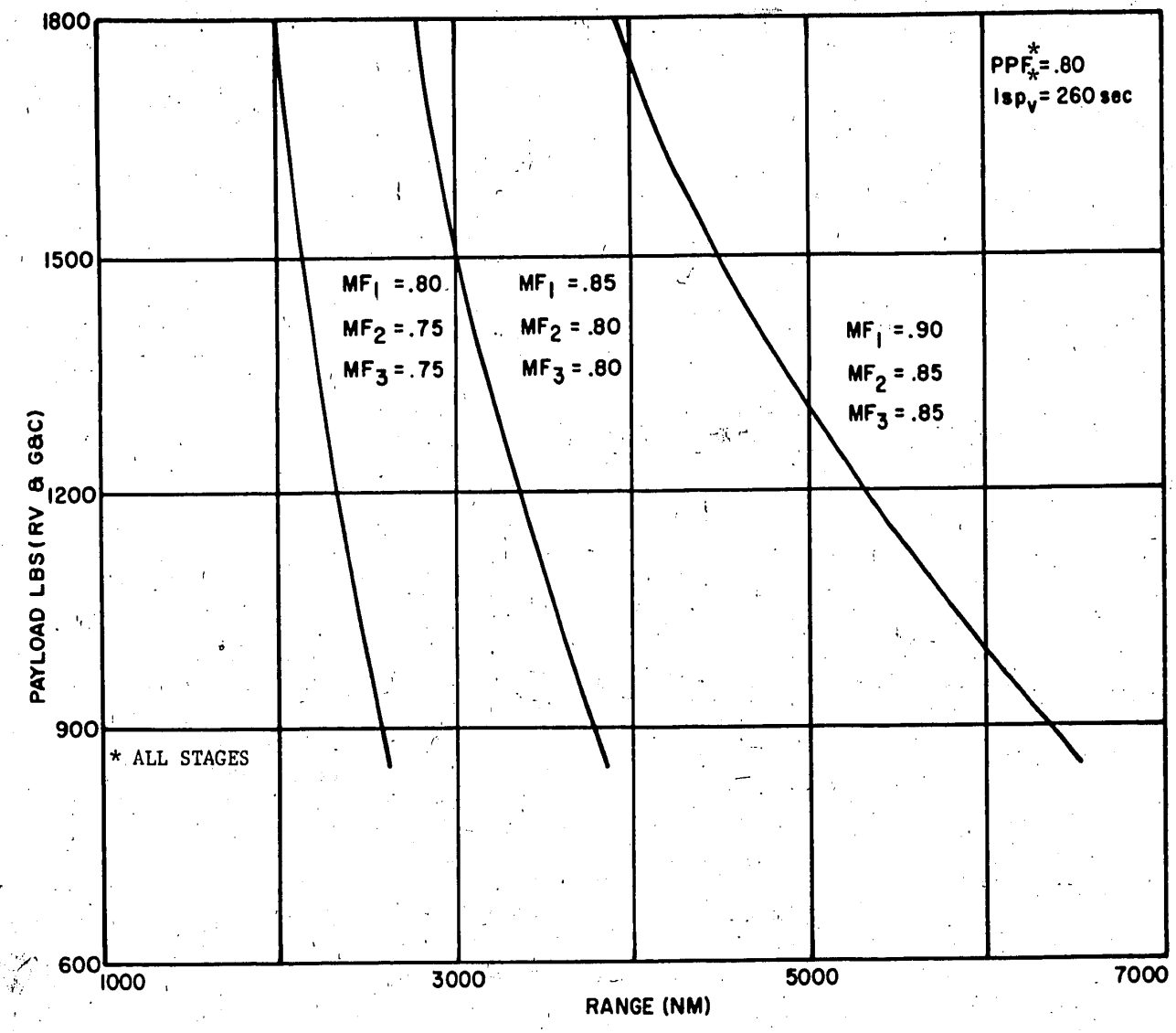

FIGURE 15. PARAMETRIC STUDY OF MASS FRACTION (MF) vs RANGE AND PAYLOAD FOR THE SAVAGE THREE-STAGE MISSILE.

TOP SECRET

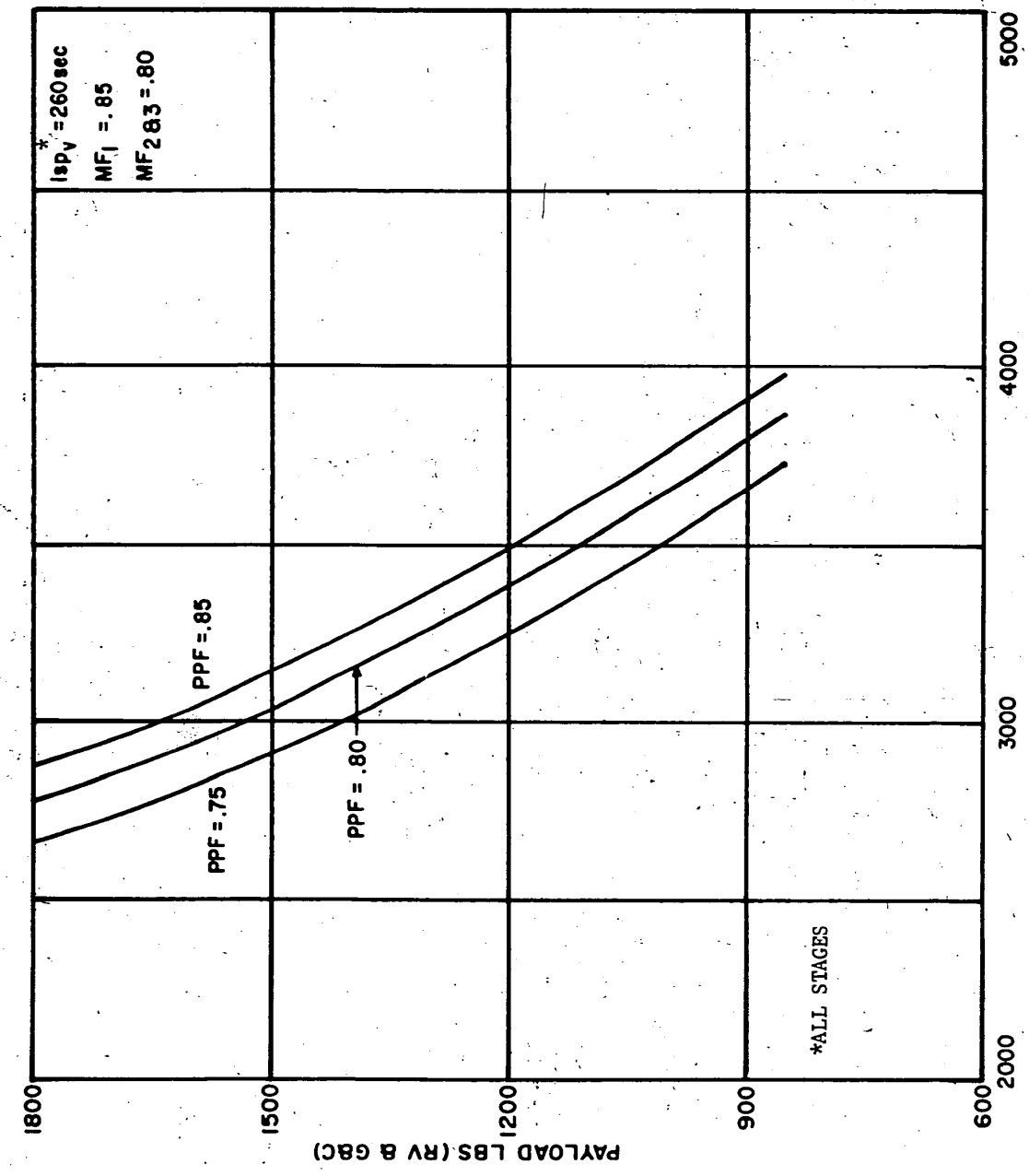

FIGURE 16. PARAMETRIC STUDY OF PROPELLANT PACKING FRACTION (PPF) vs RANGE AND PAYLOAD FOR THE SAVAGE THREE-STAGE MISSILE.

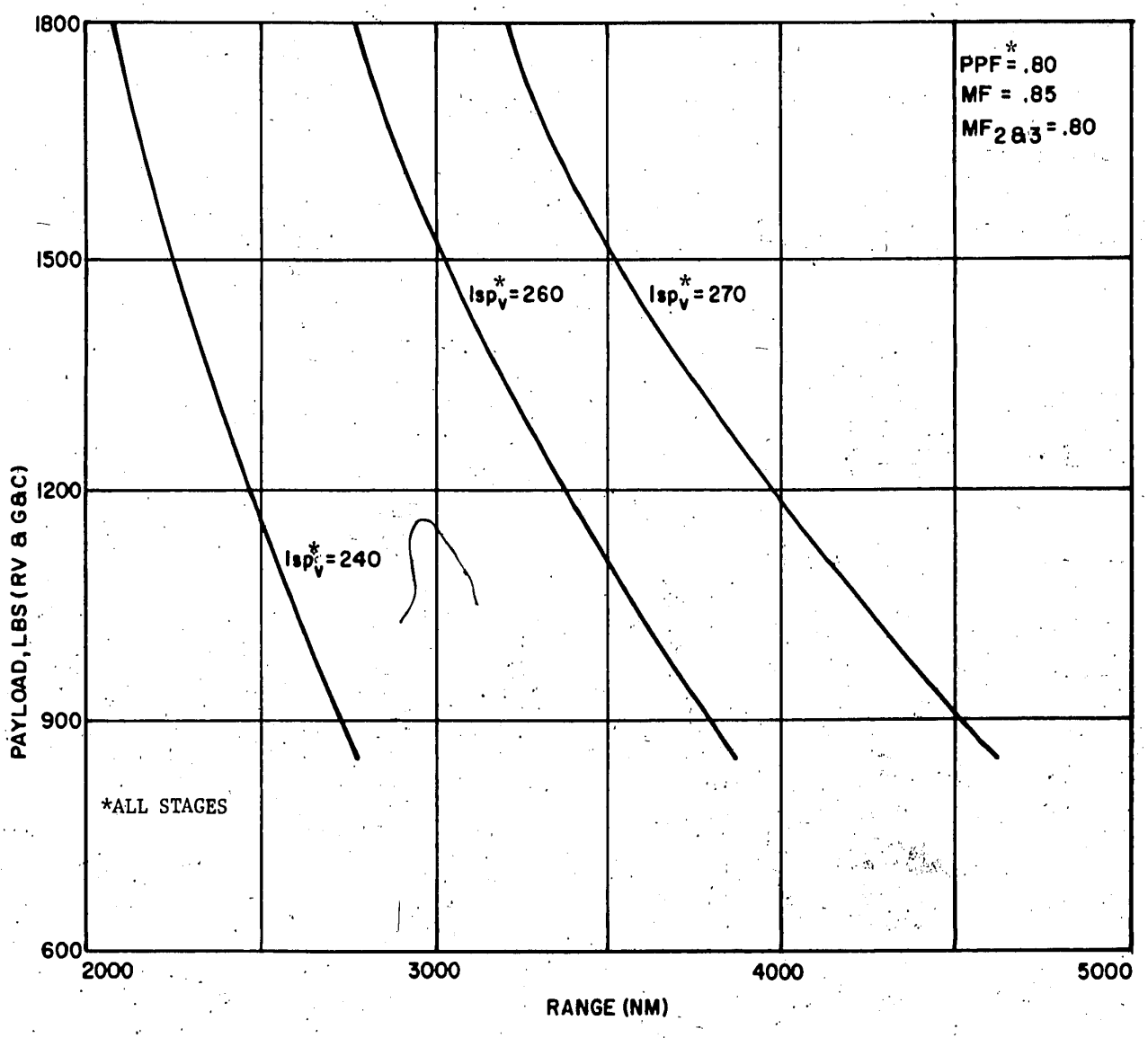

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FIGURE 17. PARAMETRIC STUDY OF VACUUM SPECIFIC IMPULSE ISP_v vs RANGE AND PAYLOAD FOR THE THREE-STAGE MISSILE.

d. Re-entry vehicle packing density (PD_{rv}).

e. Guidance and control packing density ($PD_{g\&c}$).

The variations considered are all within U.S. state-of-the-art figures and are also considered to be within U.S.S.R. state-of-the-art figures. A propellant density of 107 lb/ft^3 was assumed to be the propellant density of the SAVAGE motor sections. Since the propellant density of a double-base or modified double-base propellant is slightly less than that of a composite and the I_{sp} is slightly greater, it was felt that the use of 107 lb/ft^3 as the propellant density would effect the study only a negligible amount. The volume of the motor cases, the guidance package, and the re-entry vehicle were determined from scalings of the parade photography. The ranges shown were determined by using a computer synthesized trajectory optimized for maximum range.

As a result of the study it can be seen that of the three variables graphed versus range and payload, the PPF would make little difference while the MF and I_{sp} are more critical. Thus, the task of picking the most probable configuration depends on the MF and the I_{sp}. An assumed value of 260 seconds (vacuum) was the choice for the I_{sp}, in the light of current state-of-the art figures (Table 6). The easiest and most profitable way to increase range is to increase the mass fraction. In the United States, the mass fraction has been increased by using a filament-wound fiberglass case, e.g., MINUTEMAN third stage and POLARIS A-3 second stage. Although problems in making fiberglass cases are difficult, it is less difficult than attempting to increase the vacuum specific impulse by any appreciable amount.

3. Three-Stage Solid Missile Transporter

This entire vehicle is of considerably heavier construction than any previously shown Soviet missile transporter because of the greatly increased load of a solid propellant missile. The two main longitudinal beams are set inside of the wheels and incorporate inclosed box construction ends fore and aft, fabricated from flat plate and joined by both welding a riveting. The forward ends of the beams are off-set to form a gooseneck over the forward axle. The mid portion of the beams is open for weight reduction.

The running gear is composed of a single forward axle incorporating wagon steering and two tandem rear axles. All three axles are fitted with single wheels fitted with tires that could give the vehicle a gross weight capability of up to 129,000 pounds at a speed of 30 mph.

The tow bar is lattice construction fabricated from round tubular stock. A cylinder is mounted on each side of the transporter end of the tow bar in a position that gives it the appearance of a device for actuating the transporter brakes in the event of accidental breakaway from the towing vehicle. This is the first time that a safety device of this type has been noted.

TABLE 6. ESTIMATED CHARACTERISTICS FOR THE SAVAGE THREE STAGE SOLID

	1st Stage	2nd Stage	3rd Stage
Ignition Weight (lb)	100,900	32,900	9300
Burnout Weight (lb)	39,700	12,860	2804
Vacuum Thrust (lb)	265,200	86,800	29,100
Flow Rate (lb/sec)	1020	334	112
Burn Time (sec)	60	60	58
Mass Ratio	2.54	2.55	3.25
RV Weight (lbs)	-	-	800
G&C Weight (lbs)	-	-	250
Range (nm)	-	-	5700
Apogee (nm)	-	-	650
Total Flight Time (sec)	-	-	1840
PPF	0.80	0.80	0.80
MF	0.90	0.85	0.85
$I_{sp(v)}$	260	260	260

The missile is supported on the transporter on three saddles, one at the circumferential joint of the engine skirt, one at the forward end of the first stage and one at the forward end of the second stage. Tie downs are provided at the forward and aft saddles. The forward tie is vertical on each side to pin in the missile body. The aft tie is an inverted V-type on each side, also to a pin in the missile body.

The transporter incorporates a walkway completely around the missile, fabricated from nonskid pierced plates, with folding ladders on each side for access from the ground.

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SOLID PROPELLANT SPECIFIC IMPULSE

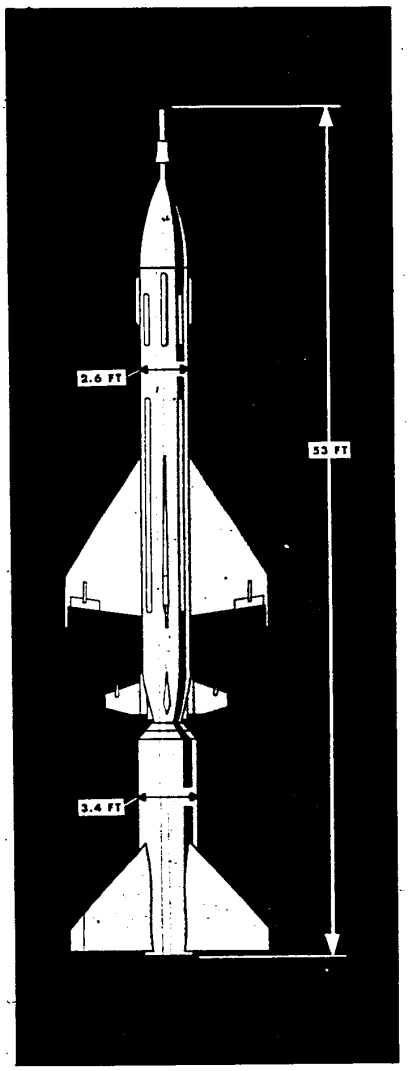
TYPE	PROPELLANT	CURRENT END USE	SEA LEVEL SPECIFIC IMPULSE*	VACUUM SPECIFIC IMPULSE**
Double-Base	ARP (cast D. B.)	HONEST JOHN	212	249
Composite	Carboxy-Terminated Polybutadiene	PERSHING	247	285
Composite	CRAN, 90% Solids	MINUTEMAN	249	287
Composite	Nitropolyurethane	POLARIS A-3	254	293
Composite Modified Double Base	AP Modified D. B.	MAULER	246	283
Composite Modified Double Base	HMX Modified D.B.	MINUTEMAN POLARIS A-3	253	291
Composite Modified Double Base	HMX, TMETN Slurry Cast D. B.	M-MOTOR	257	297

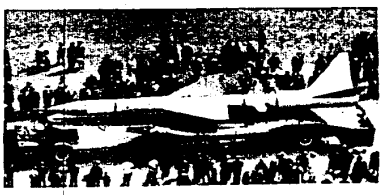
*Chamber pressure = 1000 psia
Divergence = 15°
Exit pressure = 14.7 psia
Expansion Ratio = 9
Specific heat ratio = 1.2

**Chamber pressure optional
Divergence = 15°
Exit pressure = 0 psia
Expansion ratio = 20
Specific heat ratio = 1.2

TOP SECRET

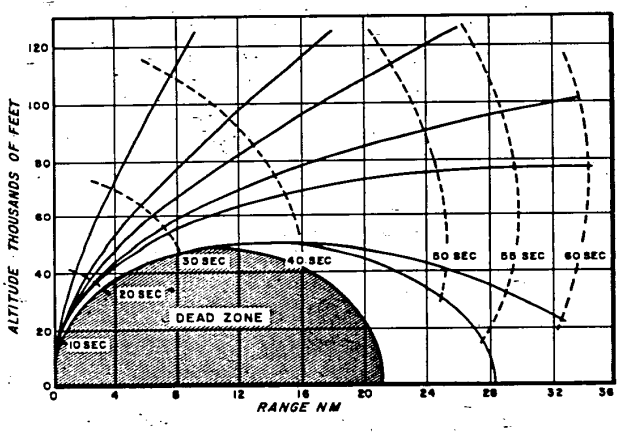
ANNEX D. SOVIET MISSILE CHARACTERISTICS AND LAUNCH ACTIVITY TABULATIONS



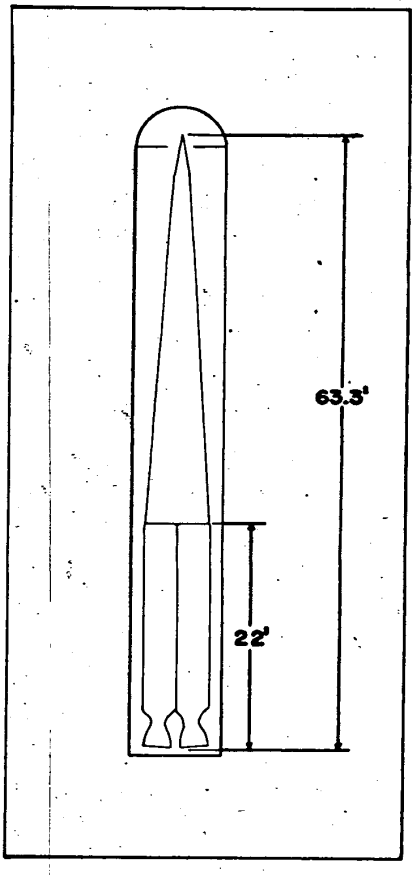


SYSTEM CHARACTERISTICS

U.S. DESIGNATION GRIFFON	SOVIET DESIGNATION UNKNOWN
CONFIGURATION	
STAGES	TWO
PROPULSION	
BOOSTER	DOUBLE BASE
SUSTAINER	NITRIC ACID/KEROSENE
WEIGHT	
LAUNCH	17,200 LBS
EMPTY	7,020 LBS
THRUST	
BOOSTER	252,200 LBS
SUSTAINER	29,300 LBS
BURNING TIME	
BOOSTER	4.1 SEC
SUSTAINER	40.0 SEC
SPECIFIC IMPULSE	
BOOSTER (S/L)	226 SEC
SUSTAINER (S/L)	215 SEC
MAXIMUM EFFECTIVENESS	
VELOCITY	MACH 6.5
MANEUVERING ALTITUDE	100,000 FT
ENGAGEMENT RANGE (60 SEC)	34 NM



(S) GRIFFON System Characteristics (U)



SYSTEM CHARACTERISTICS

U. S. NAME GALOSH — MISSION AMM

CONFIGURATION — STAGES
TANDEM — TWO

WEIGHT
- BOOSTER — 45,000 LBS
- SUSTAINER — 15,000 LBS
- WARHEAD — 2,200 LBS

THRUST
- 1st STAGE (SL) — 1,000,000 LBS-
- 2nd STAGE (SL) — 250,000 LBS

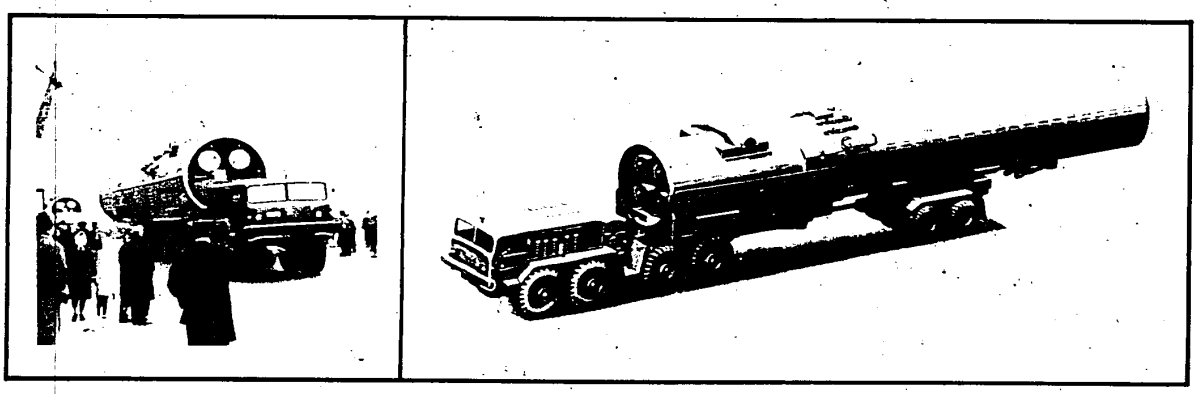
BURNING TIME
- 1st STAGE (SL) — 6.5 SEC.
- 2nd STAGE (SL) — 6.5 SEC.

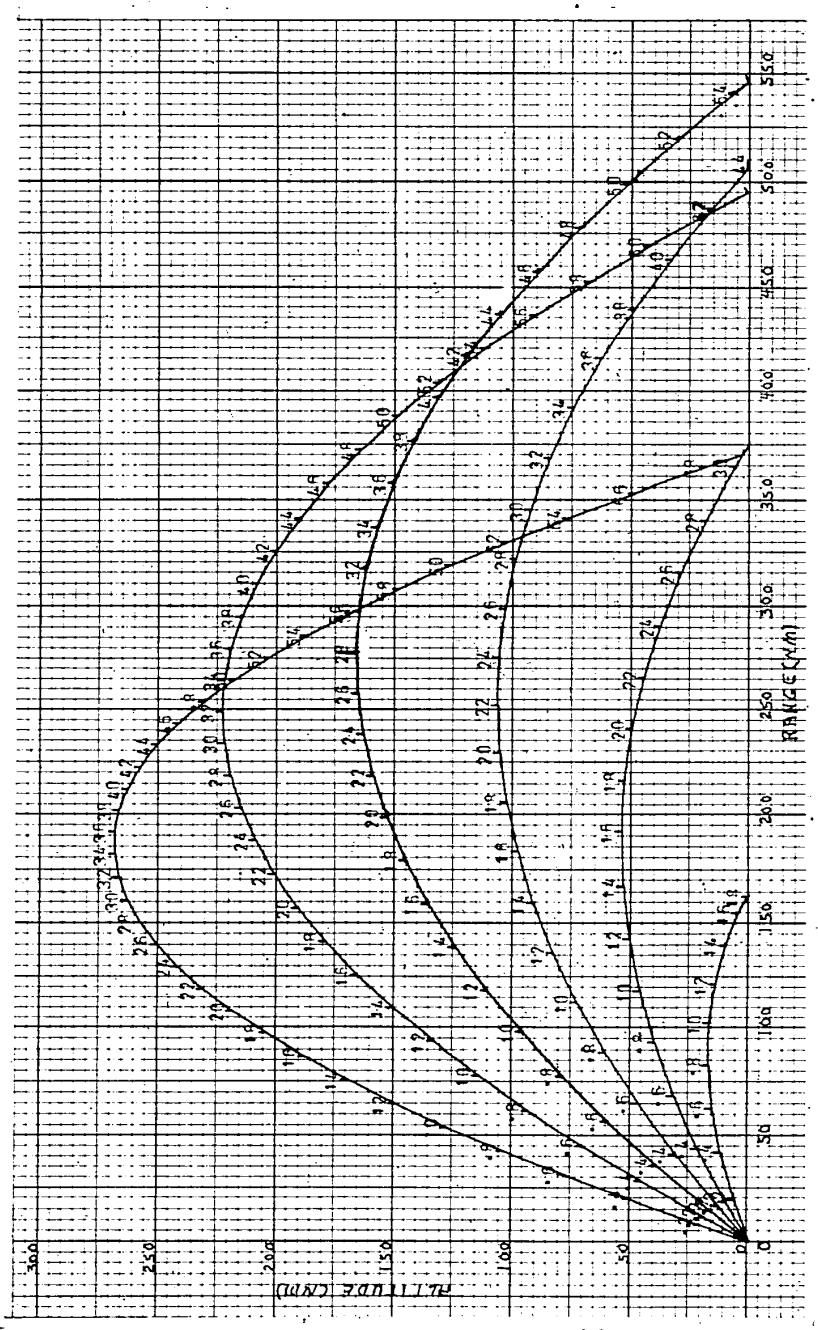
PROPULSION
- 1st STAGE (SL) — DOUBLE BASE
- 2nd STAGE (SL) — RFNA/KEROSENE

LAUNCHER — TRANSPORTER/CONTAINER

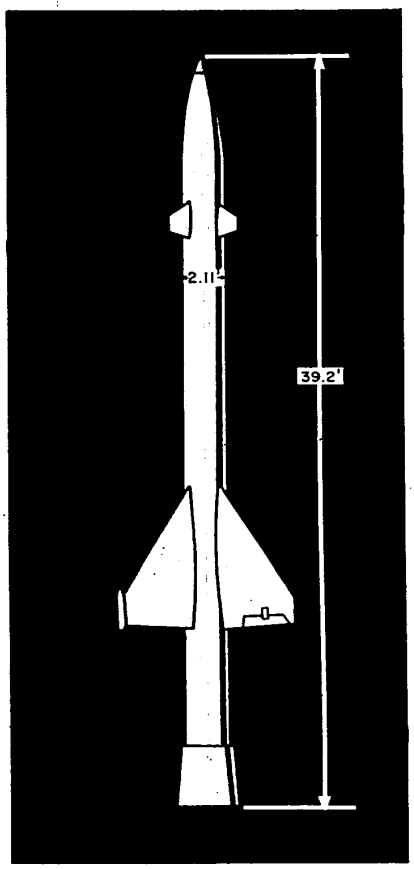
GUIDANCE
(EST.) — COMMAND

* SEE FLY-OUT ENVELOPE ON REVERSE SIDE





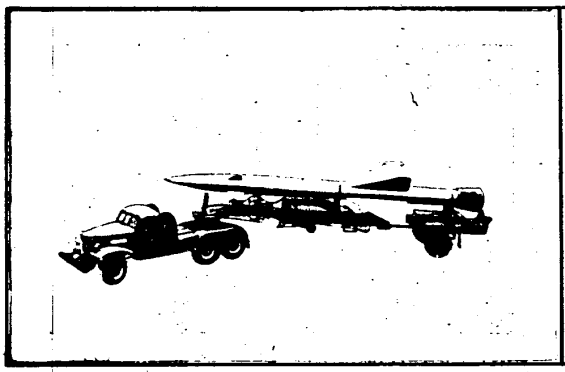
PERFORMANCE CURVES FOR THE GALOSH MISSILE

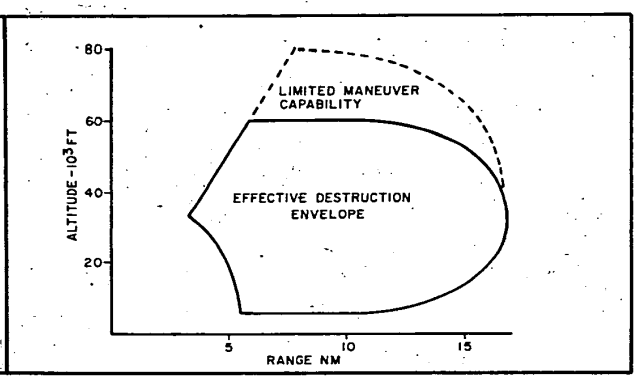


SYSTEM CHARACTERISTICS

U.S. NICKNAME SA-1 (GUILD) SOVIET DESIGNATION V-301

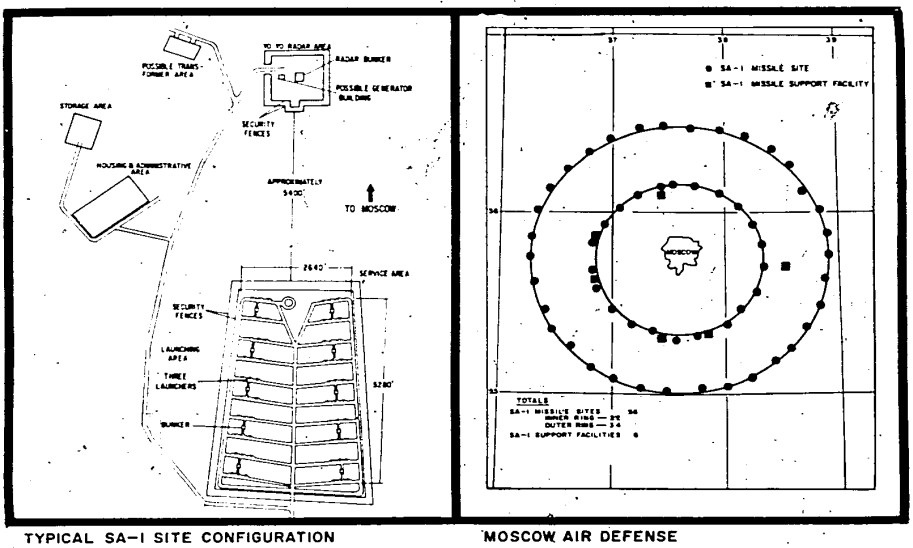
CONFIGURATION	
CONFIGURATION	SINGLE STAGE
PROPULSION	
PROPULSION	NITRIC ACID/KEROSENE
WEIGHT	
EMPTY (APPROX)	3000 LBS
LAUNCH (APPROX)	7500 LBS
WARHEAD	500 LBS
THRUST	
THRUST	20,000-22,000 LBS
SPECIFIC IMPULSE	
SPECIFIC IMPULSE	210-230 SEC
MAXIMUM VELOCITY	
MAXIMUM VELOCITY	MACH 3
BURNING TIME	
BURNING TIME	50 SEC
EFFECTIVENESS	
MAXIMUM ALTITUDE	60,000-80,000 FT
MINIMUM ALTITUDE	6000 FT
MAXIMUM ENGAGEMENT RANGE	20-25 NM
MINIMUM ENGAGEMENT RANGE	5-6 NM





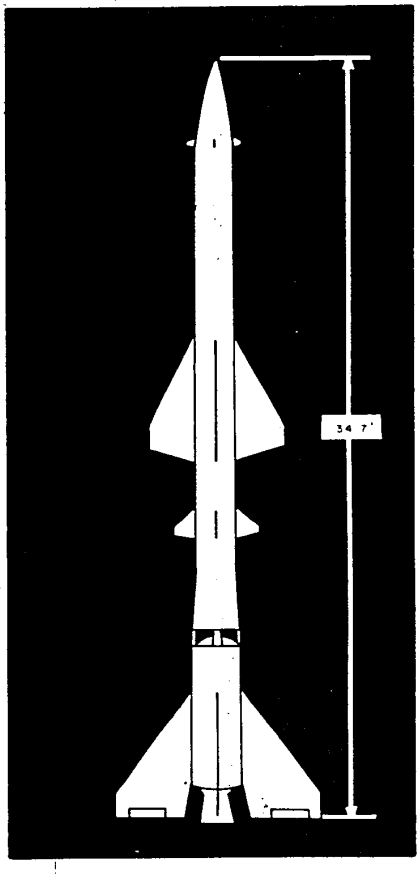
(S) SA-1 System Characteristics (U)

U.S. DESIGNATION YO-YO	SOVIET DESIGNATION UNKNOWN
PURPOSE	TARGET TRACKING TARGET ACQUISITION MISSILE TRACKING
FREQUENCY	
INITIALLY	3250 - 3350 MCS
POSSIBLE CHANGE	3700 - 3800 MCS
PULSE REPETITION FREQUENCY	2500 PPS
PULSE WIDTH	0.4 - 0.8 MICROSEC
BEAM WIDTH	1.5 DEG
SCANNING SECTOR	54 DEG
ANTENNA SCAN RATE	5 SCANS PER SEC
MAXIMUM UNAMBIGUOUS RANGE	32 NM



TYPICAL SA-1 SITE CONFIGURATION

MOSCOW AIR DEFENSE

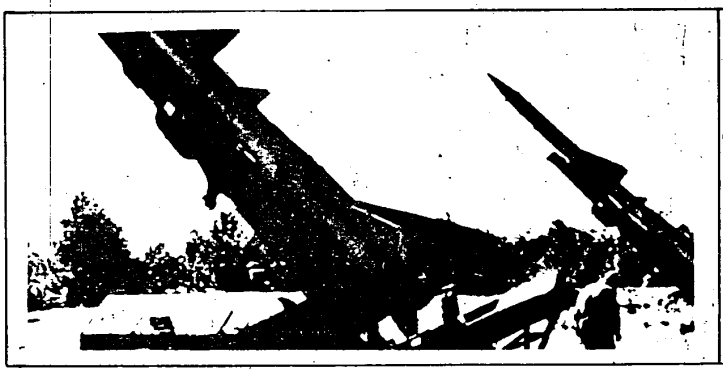


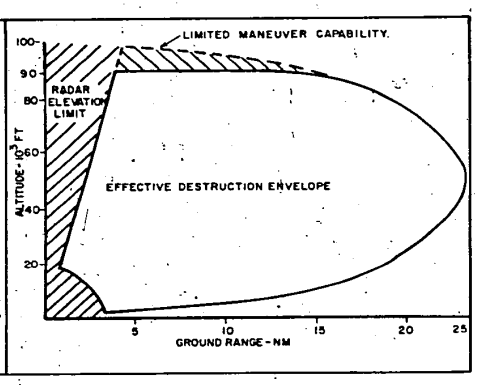
SYSTEM CHARACTERISTICS

U.S. NICKNAME SA-2 GUIDELINE — SOVIET DESIGNATION V-75

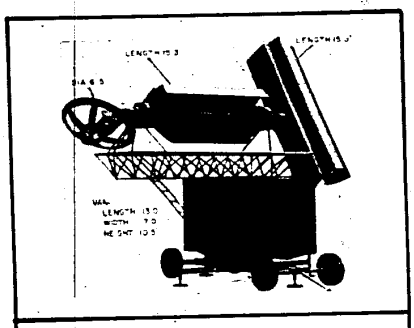
CONFIGURATION	**STAGES**
TANDEM	TWO
WEIGHT	
BOOSTER	2270 LBS
SUSTAINER	2760 LBS
WARHEAD(DIRECTIONAL, HE OR FRAGMENTATION)	420 LBS
THRUST	
BOOSTER	65,000 LBS
SUSTAINER	6600 LBS
BURNING TIME	
BOOSTER	4.3 SEC
SUSTAINER	42 SEC
PROPULSION	
BOOSTER, SOLID	DOUBLE BASE
SUSTAINER, LIQUID	NITRIC ACID/UDMH
LAUNCHER	
TYPE	SINGLE RAIL
ENGAGEMENT	
TYPE	SINGLE TARGET
EFFECTIVENESS	
MAXIMUM ALTITUDE	90,000 FT
MINIMUM ALTITUDE	*2500 FT
GUIDANCE COMMAND	
TYPE	PULSE CODED

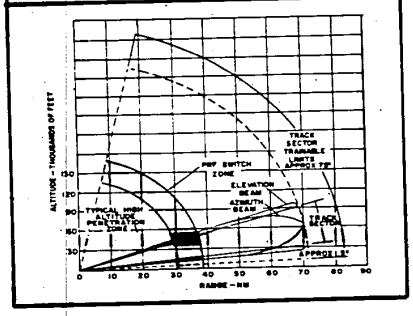
* VARIES - DEPENDING ON SITING & TARGET CONDITIONS



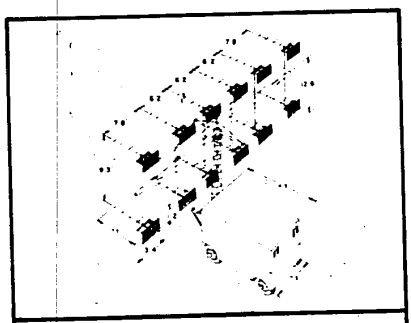


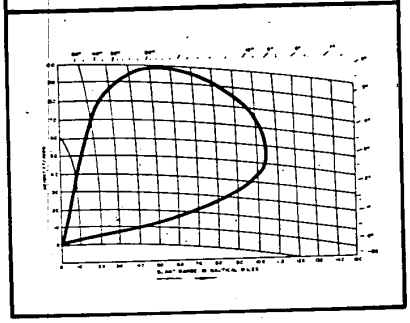
(S) SA-2 System Characteristics (U)



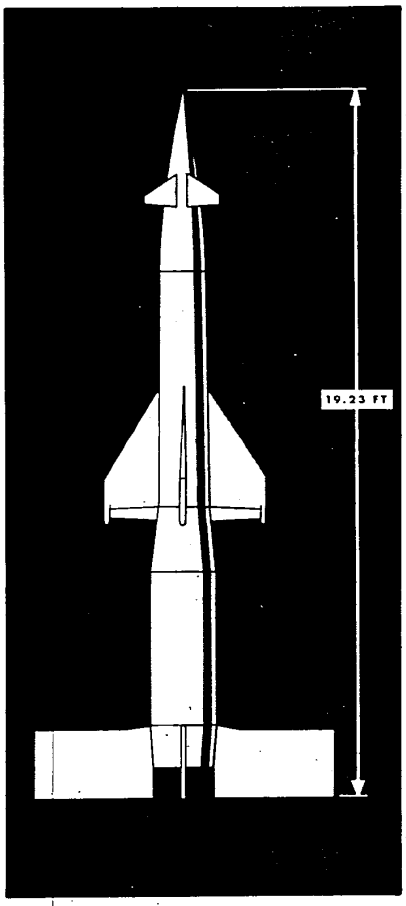


	U.S. DESIGNATION FAN SONG "C"	SOVIET DESIGNATION UNKNOWN
PURPOSE		TRACK WHILE SCAN FIRE CONTROL RADAR
FREQUENCY		
VERTICAL ANTENNA		4925-4990 MCS
HORIZONTAL ANTENNA		5020-5090 MCS
PULSE REPETITION FREQUENCY		
HIGH PRF		1861-2080 PPS
LOW PRF		963-1049 PPS
PULSE WIDTH		
HIGH PRF		0.2-0.8 μSEC
LOW PRF		0.6-1.0 μSEC
MAXIMUM UNAMBIGUOUS RANGE		
HIGH PRF		39-44 NM
LOW PRF		77-84 NM
PEAK POWER		1.2 MW/ANTENNA
AVERAGE POWER		578-1664 WATTS/ANTENNA
SCAN SECTOR		10 BY 20 DEG
SECTOR SCAN RATE		16 PER SEC
DETECTION CAPABILITY		$1M^2$ CROSS SECTION AT 32 NM(.9P_D)



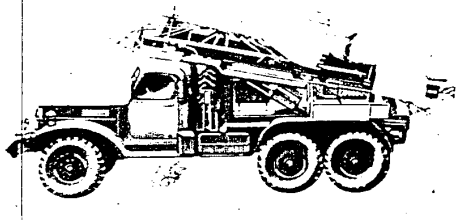


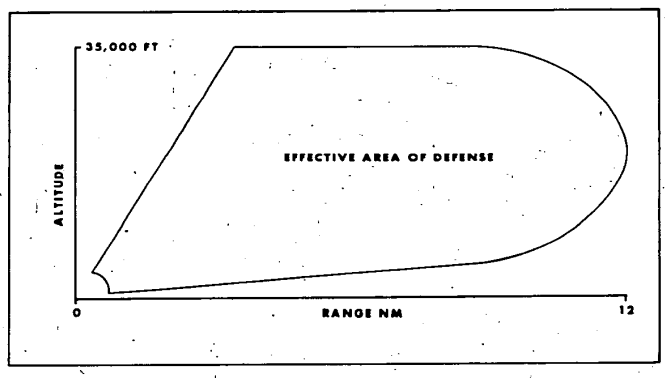
	U.S. DESIGNATION SPOON REST "A"	SOVIET DESIGNATION UNKNOWN
PURPOSE		EARLY WARNING NET SA-2 SYSTEM ASSOCIATED
FREQUENCY		150-157 MCS
PULSE REPETITION FREQUENCY		300-400 PPS
PULSE WIDTH		4-7 μSEC
ANTENNA ROTATION RATE		1.5-5 RPM
POLARIZATION		HORIZONTAL
HORIZONTAL BEAM WIDTH		5-10 DEG
VERTICAL BEAM WIDTH		35-40 DEG
PEAK POWER		375 KW
AVERAGE POWER		450-1050 WATTS
MAXIMUM UNAMBIGUOUS RANGE		202-270 NM
RANGE RESOLUTION		1970-3450 FT
APPROXIMATE RANGE ACCURACY		2500 FT
AZIMUTH RESOLUTION		5-10 DEG
APPROXIMATE AZIMUTH ACCURACY		1 DEG
PULSES/BEAM WIDTH DURING SCANNING		60-267
DETECTION CAPABILITY		$1M^2$ CROSS SECTION AT 29 NM(.9P_D)



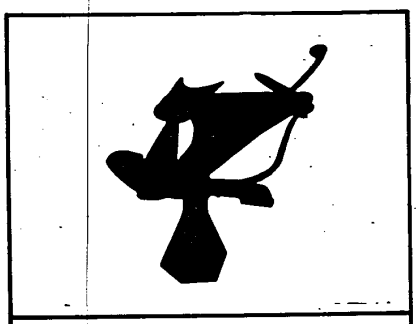
SYSTEM CHARACTERISTICS

U.S. DESIGNATION SA-3 GOA	SOVIET DESIGNATION UNKNOWN
CONFIGURATION TANDEM	**STAGES** TWO
WEIGHT	
BOOSTER	980 LBS
SUSTAINER	1070 LBS
WARHEAD (HE FRAG)	175 LBS
THRUST	
BOOSTER	30,500 LBS
SUSTAINER	3500 LBS
PROPULSION	
BOOSTER & SUSTAINER	DOUBLE BASE SOLID
LAUNCHER	
TYPE	DUAL,"O" LENGTH
EFFECTIVENESS	
MAXIMUM EFFECTIVE ALTITUDE	35,000 FT
RANGE	12 NM
GUIDANCE	
TYPE	UNKNOWN

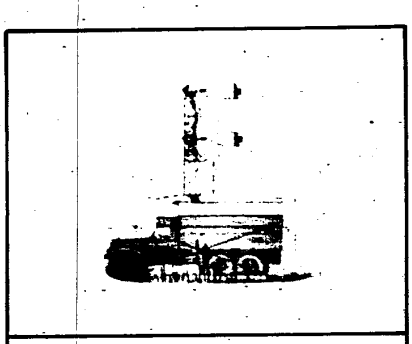


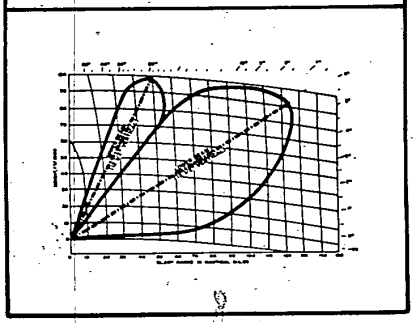


(S) SA-3 System Characteristics (U)

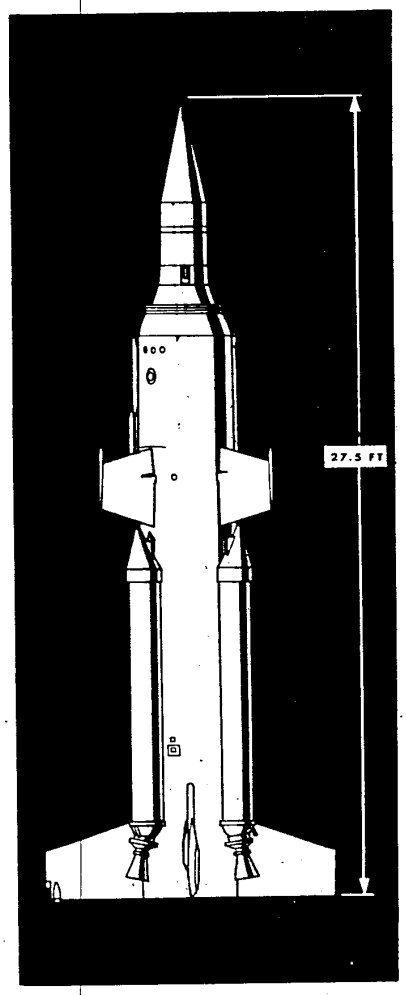


U.S. DESIGNATION UNNAMED	SOVIET DESIGNATION UNKNOWN
PURPOSE	MULTIPURPOSE GUIDANCE RADAR
TYPE	MULTIANTENNA CONFIGURATION MOUNTED ON SINGLE PEDESTAL
OTHER CHARACTERISTICS	UNKNOWN



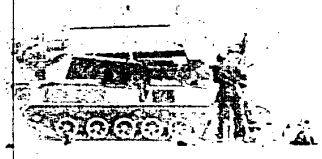


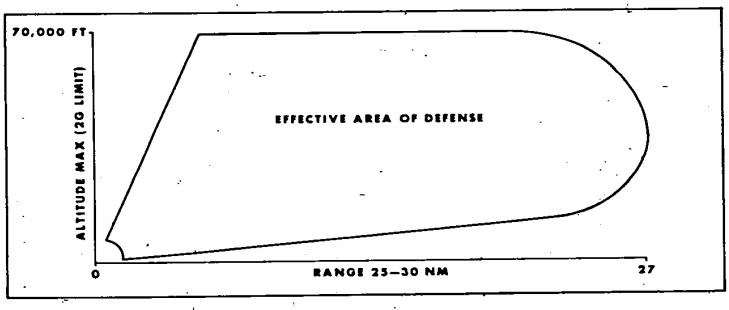
U.S. DESIGNATION FLAT FACE	SOVIET DESIGNATION UNKNOWN
PURPOSE	EARLY WARNING NET SA-3 SYSTEM ASSOCIATED
FREQUENCY	822-836 MCS 880-900 MCS
PULSE WIDTH	1.5- 2.5 μSEC
PRF	480-520 PPS 630-710 PPS
UNAMBIGUOUS RANGE (MAX)	168 NM
ECCM	MTI/IAGC/FTC
PEAK POWER	500 KW/ANTENNA
SCAN RATE	1/6 - 7.0 RPM
VERTICAL BEAM WIDTH	12 1/2 DEG
HORIZONTAL BEAM WIDTH	4 1/2 DEG
DETECTION CAPABILITY	$1 M^2$ CROSS SECTION AT 41NM(.9P_D)



SYSTEM CHARACTERISTICS

U.S. DESIGNATION GANEF	SOVIET DESIGNATION UNKNOWN
CONFIGURATION TANDEM	**STAGES** TWO
WEIGHT	
BOOSTER	2200 LBS
SUSTAINER	3300 LBS
WARHEAD (HE FRAG)	400 LBS
THRUST	
BOOSTER	21,000 LBS
SUSTAINER	20,000 LBS (MAX)
BURNING TIME	
BOOSTER	3.75 SEC
SUSTAINER	20–50 SEC
PROPULSION	
BOOSTER (SOLID)	DOUBLE BASE
SUSTAINER (RAMJET)	GASOLINE–KEROSENE
LAUNCHER	
TYPE	MOBILE, DUAL, "O" LENGTH
AZIMUTH LIMITS	360°
ELEVATION LIMITS	20° TO 60°



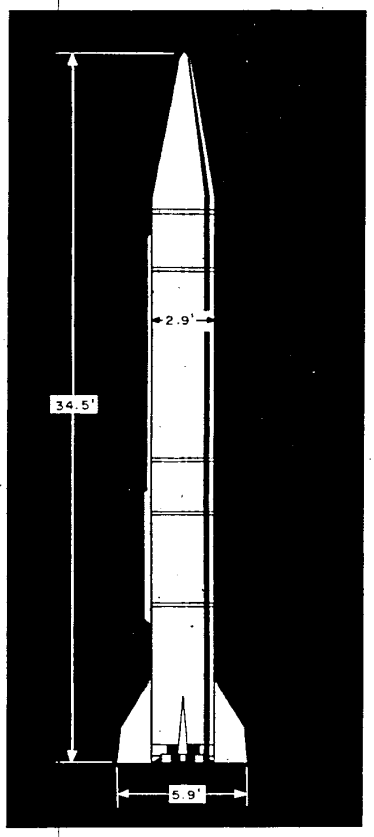


(S) GANEF System Characteristics (U)

BALLISTIC MISSILES TESTED AT KAPUSTIN YAR

MILITARY REQUIREMENT	MISSILE DESIGNATOR	U. S. DESIGNATOR	U. S. NICKNAME	RANGE	FIRST TEST	IOC	PROPELLANT	GUIDANCE	CURRENT STATUS
R-1	8A11	SS-1a	SCUNNER	150	(1950)	1954	Non-Stor	R/I	Obsolete
R-11	8A61	SS-1b	SCUD A	150	1954	1957	Storable	I	Deployed
R-11	8K11	SS-1b	SCUD A	80	1955	1958	Storable	I	Deployed
R-11	8K14	SS-1c	SCUD B	150	1959	1961	Storable	I	Deployed
-	8.12	-	-	150	1956	-	-	-	-
R-2	8Zh38	SS-2	SIBLING	300	(1952)	1954	Non-Stor	R/I	Obsolescent
(R-10)*	8.62	-	-	620	1953	-	Non-Stor	-	-
(R-5)	8K51	SS-3	SHYSTER	620	1955	1956	Non-Stor	R/I	Obsolescent
R-7	8K52	-	-	620	1957	-	Non-Stor	-	-
R-12	8K63	SS-4	SANDAL	1020	1957	1958	Storable	I	Deployed
R-14	8K65	SS-5	SKEAN	2200	1960	1961	Storable	I	Deployed
R-13	(8K64)	SS-N-4	-	300	1959	1960	Storable	I	Deployed
-	-	KY-1	(SARK)	1000	1962	-	-	-	Special Test
-	-	KY-2	-	500	1964	1965	-	-	Operational
-	-	KY-3	-	300-450	1964	-	-	-	R&D
-	-	KY-4	-	150	1964	-	-	-	R&D

*( ) indicate a tentative correlation.



SYSTEM CHARACTERISTICS

U.S. DESIGNATION
SS-1B SCUD A

SOVIET DESIGNATION
R-11 (8A61)

ENGINES
ONE

STAGES
ONE

IOC-1957

VEHICLE WEIGHTS

AT LIFTOFF	11,890 LBS
AT BURNOUT	4,150 LBS
USABLE PROPELLANT	7,740 LBS
PAYLOAD WEIGHT	1,166 LBS

PROPULSION UNIT

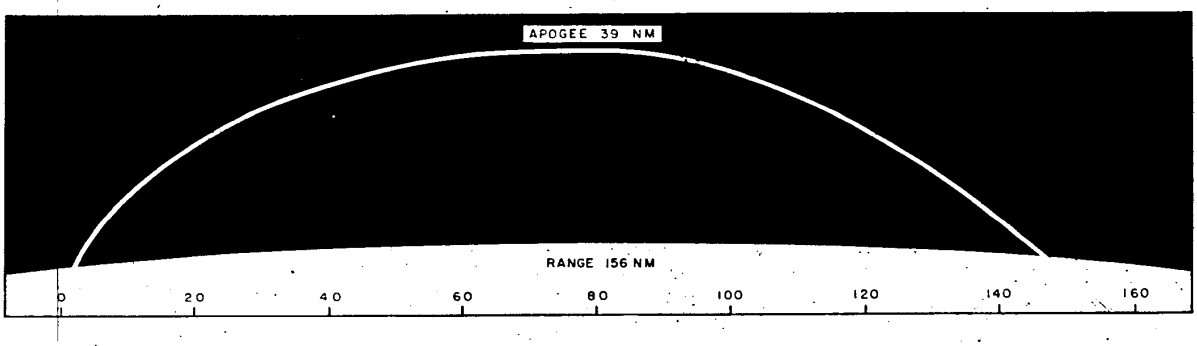
SEA LEVEL THRUST	18,300 LBS
BURNING TIME (MAXIMUM)	92 SEC

TRAJECTORY DATA

TOTAL FLIGHT TIME	310 SEC
BURNOUT VELOCITY	4,900 FPS
BURNOUT ANGLE	37°
MAXIMUM THRUST ACCELERATION	5 G'S
GUIDANCE TECHNIQUE	INERTIAL

PROPELLANT

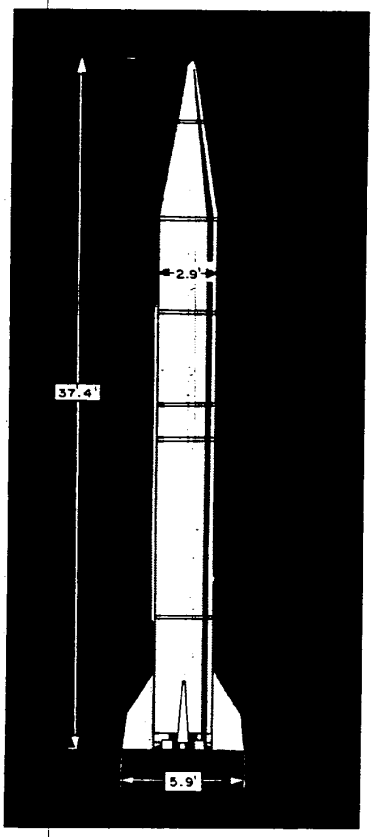
MIXTURE RATIO (O:F)	1.90
MASS RATIO	2.9
SPECIFIC IMPULSE (S/L)	218 SEC
PROPELLANT FLOW RATE	84 LBS/SEC
TYPE	IRFNA/HYDROCARBON
CEP	.5 NM

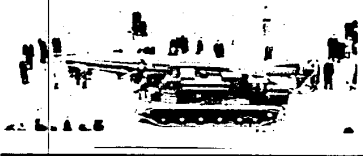


(S) SCUD A System Characteristics (U)

SHORT RANGE BALLISTIC MISSILE ACTIVITY

YR	QTR	8A11 R&D	8A11 OPN	8A61 R&D	8A61 OPN	8K11 R&D	8K11 OPN	8K14 R&D	8K14 OPN	12 R&D	12 OPN	75 nm R&D	75 nm OPN	150 nm R&D	150 nm OPN	8Zh38 R&D	8Zh38 OPN	R-13 R&D	R-13 OPN
53	4															1			
1954	1															1			
	2	5														5			
	3	1	2													1			
	4	1	1	3												5	3		
1955	1	5	6	6												8	1		
	2		4	6												6	4		
	3			6												7	4		
	4					1										6	5		
1956	1		4			2										2			
	2	1		1						10						1	1		
	3	1				4										2			
	4		5													3			
1957	1	1	6	2		1										1			
	2		2			1										1	2		
	3			6		3											18		
	4		6	8	1	3										3	6		
1958	1		5	1	1												2		
	2		2	1	1												10		
	3		7	1	8														
	4			1		5	2												
1959	1		1	1	6	3											1		
	2			1	4	3	4										12	1	
	3		1			2	10										13	10	
	4		2	5	2	1	12	2									12	2	
1960	1				7	3	7	3										5	1
	2				8	3	4										1		
	3				14		4	3									8		
	4				8	2		6									15		
1961	1											6	3	14			2		
	2											13	1	4			8		
	3											7	4	9			32		
	4											8	4	6			3		
1962	1											8	2	4					
	2											4	4	2					
	3										3	4	2	8					
	4											3	5	7					
1963	1											4	1	4					
	2											2	2						
	3												1						
	4											8		1					
1964	1													2					
	2												2	1					
	3											5	3	25					
	4												1	22					
1965	1													5					
	2													8					
	3																		
	4																		
TOTAL		15	54	49	60	37	43	14		10		3	72	35	122	53	163	18	1





SYSTEM CHARACTERISTICS

U.S. DESIGNATION
SS-1C SCUD B

SOVIET DESIGNATION
UNKNOWN

I.O.C. 1961

ENGINES
ONE

STAGES
ONE

VEHICLE WEIGHTS

AT LIFTOFF	13,300 LBS
AT BURNOUT	4,650 LBS
USABLE PROPELLANT	8,650 LBS
PAYLOAD WEIGHT	2,000 LBS

PROPULSION UNIT

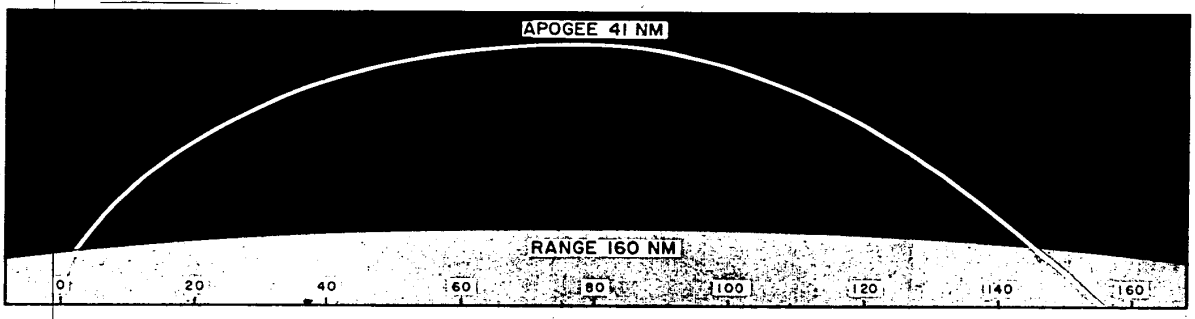
SEA LEVEL THRUST	20,525 LBS
BURNING TIME (MAXIMUM)	92 SEC

TRAJECTORY DATA

TOTAL FLIGHT TIME	310 SEC
BURNOUT VELOCITY	5,000 FPS
BURNOUT ANGLE	37°
MAXIMUM THRUST ACCELERATION	5 G'S
GUIDANCE TECHNIQUE	INERTIAL

PROPELLANT

MIXTURE RATIO (O:F)	1.90
MASS RATIO	2.9
SPECIFIC IMPULSE (S/L)	220 SEC
PROPELLANT FLOW RATE	93 LBS/SEC
TYPE	IRFNA/HYDROCARBON
CEP	.4 NM



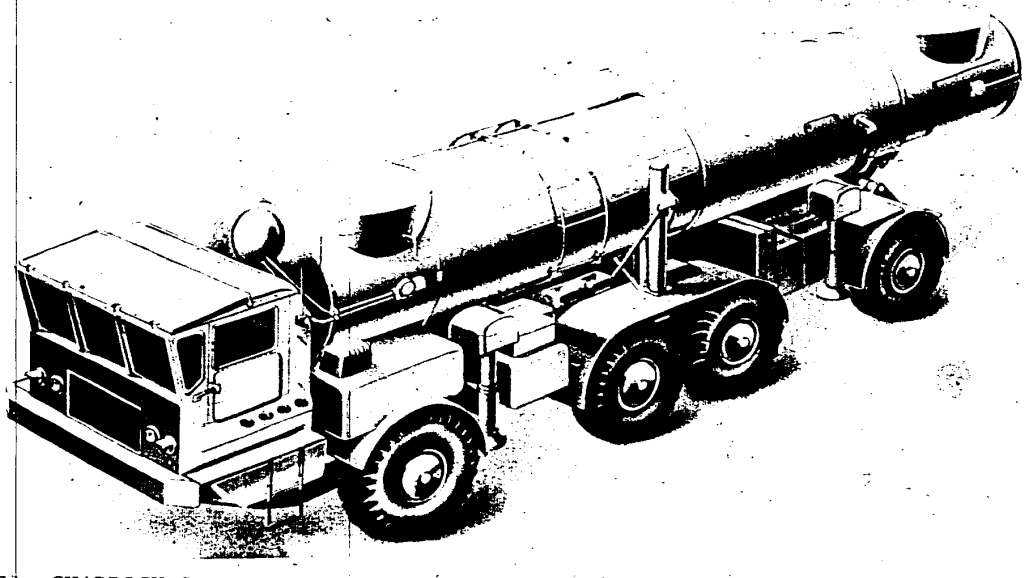
(S) SCUD B System Characteristics (U)

CRUISE MISSILE TESTS - KYMTR

MISSILE DESIGNATOR	RANGE (NM)	NUMBER TESTS	NUMBER SUCCESS	FIRST TEST	LAST TEST	USE
P-10	75	5	4	11/3/57	17/5/57	Possible Ground Forces.
10X	150	5	4	4/7/57	18/7/57	Unknown.
P-5	150	48	39	Aug 57	Present	SHADDOCK
P-5	300	89	81	27/9/60	Present	SHADDOCK - SS-N-3A.
P-6	150	6	5	29/10/59	27/4/60	Naval
P-35	150	5	0	21/10/59	17/3/60	Cancelled
P-(8)	450	4	3	16/2/62	29/5/62	Naval

SYSTEM CHARACTERISTICS

U.S. DESIGNATION SSC-1 SHADDOCK	SOVIET DESIGNATION SP-5
VEHICLE WEIGHTS	
GROSS WEIGHT	10,000 LBS
WARHEAD WEIGHT	1000-1500 LBS
PROPULSION UNIT	
TYPE-SUSTAINER	TURBOJET
THRUST-SUSTAINER	5400 LBS
TYPE-BOOSTER	SOLID
THRUST-BOOSTER	36,000 LBS
TRAJECTORY DATA	
RANGE	300 NM
ALTITUDE	BELOW 3000 FT
SPEED	MACH 1.2
GUIDANCE	AUTONOMOUS (POSS WITH TERMINAL HOMING)
IOC	1959
CEP	500 FT
LENGTH	37 FT
DIAMETER	3 FT
WING SPAN	5.8 FT

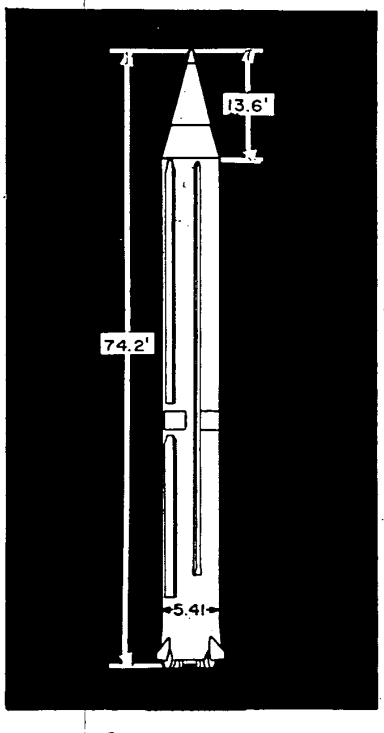


(S) SHADDOCK System Characteristics (U)

BRIEF FIRING HISTORY OF SOVIET AERODYNAMIC SYSTEMS DEVELOPMENT

YR	QTR	P-10 75NM	Unk 75NM	10X 150NM	P-5 150NM	P-5 300NM	P-6 150NM	P-35 150NM	Unk 150NM	Unk 450NM	TOTAL	REMARKS
1957	1	1									1	
	2	4(1)									4(1)	
	3			5(1)	1(1)						6(2)	
	4				1(1)						1(1)	
1958	1				2(1)						2(1)	
	2				3						3	
	3				2						2	
	4				5(3)						5(3)	
1959	1				5*						5	*SK-2 equipment used for these.
	2											
	3				1						1	
	4				2		3(1)	3(3)			8(4)	
1960	1						1	2(2)			3(2)	
	2				2(1)		2				4(1)	
	3				8(2)	2					10(2)	
	4				5	5(1)					10(1)	
1961	1											E-Class sub fired mśls to 225 nm. SHADDOCK displayed.
	2					4(1)			4		8(1)	
	3		1			3(1)					4(1)	
	4					6					6	
1962	1					2				1	3	
	2					1				3(1)	4(1)	
	3					5(1)			2		7(1)	
	4					5					5	
1963	1					5					5	Heavy crew training with the SHADDOCK
	2		2			22(1)					24(1)	
	3					6(1)			1		7(1)	
	4					17(1)					17(1)	
1964	1					3(1)					3(1)	
	2					1			1		2	
	3					1			2		3	
	4					1			1		2	
1965	1											
	2								1		1	
	3											
	4											
TOTAL		5(1)	3	5(1)	37(9)	89(8)	6(1)	5(5)	12	4(1)	166(26)	

NOTE: The number in ( ) indicates failures. Example: In the 2nd quarter of 1957 there were four "P-10" launchings and one of the four failed.



SYSTEM CHARACTERISTICS

U.S. DESIGNATION SS-4 SANDAL — **SOVIET DESIGNATION UNKNOWN**

STAGES	**ENGINES**
ONE	ONE (FOUR COMBUSTION CHAMBERS)
IOC-1958	

VEHICLE WEIGHTS

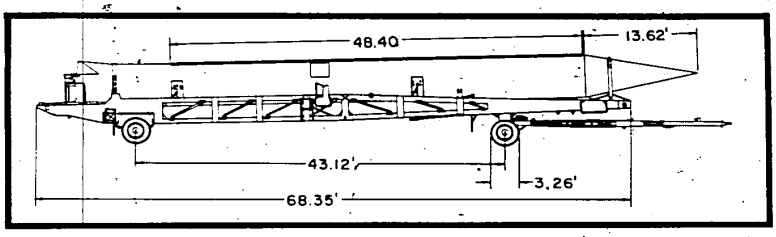
AT LIFT OFF	83,000 LBS
AT BURNOUT	12,000 LBS
PROPELLANT WT (USABLE)	71,000 LBS
RE-ENTRY VEHICLE WT	2700-3200 LBS
WARHEAD WT	1840-2200 LBS

PROPULSION UNIT

BURNING TIME (TOTAL)	129.84 SECS
BURNING TIME (EFFECTIVE)	129 SECS
THRUST (VACUUM)	145,000 ± 8000 LBS
MASS RATIO	6.9 ± .15
MAXIMUM ACCELERATION	11.0 G'S

PROPELLANT

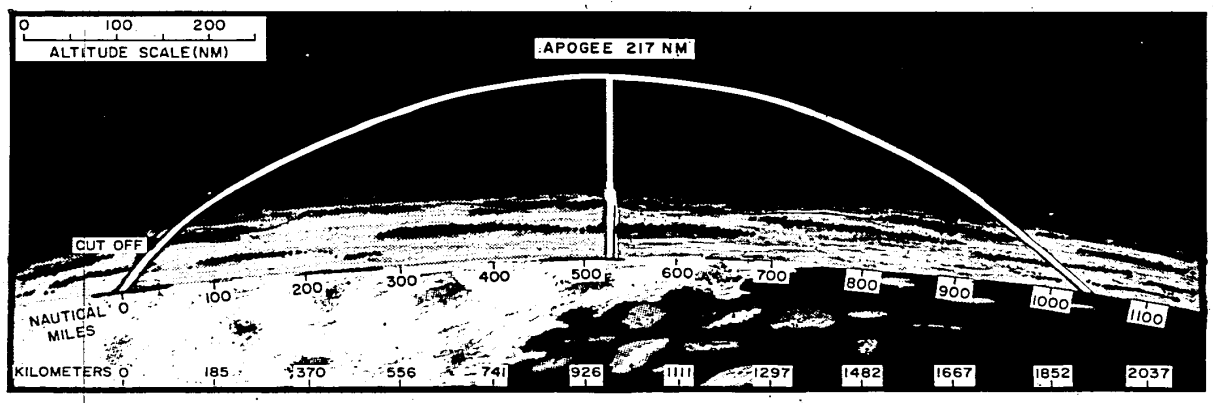
MIXTURE RATIO (VOL-O:F)	1.91:1
FLOW RATE	550 LBS/SEC
SPECIFIC IMPULSE (VAC)	260 ± 4
TYPE	IRFNA/HYDROCARBON



TRAJECTORY DATA

TOTAL FLIGHT TIME	755 SECS
BURNOUT VELOCITY	12,570 FT/SEC
BURNOUT ANGLE	35
MAXIMUM RANGE*	1020 NM
MINIMUM RANGE	350 NM
CEP	1.5 NM

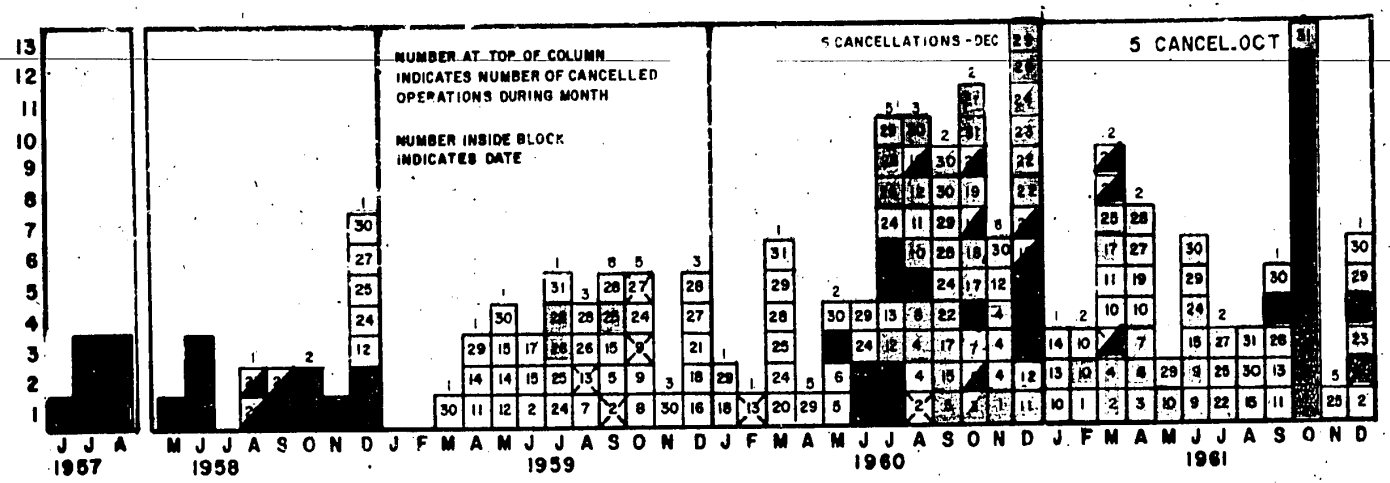
*NON-ROTATING EARTH



(S) SS-4 System Characteristics (U)

TOP SECRET

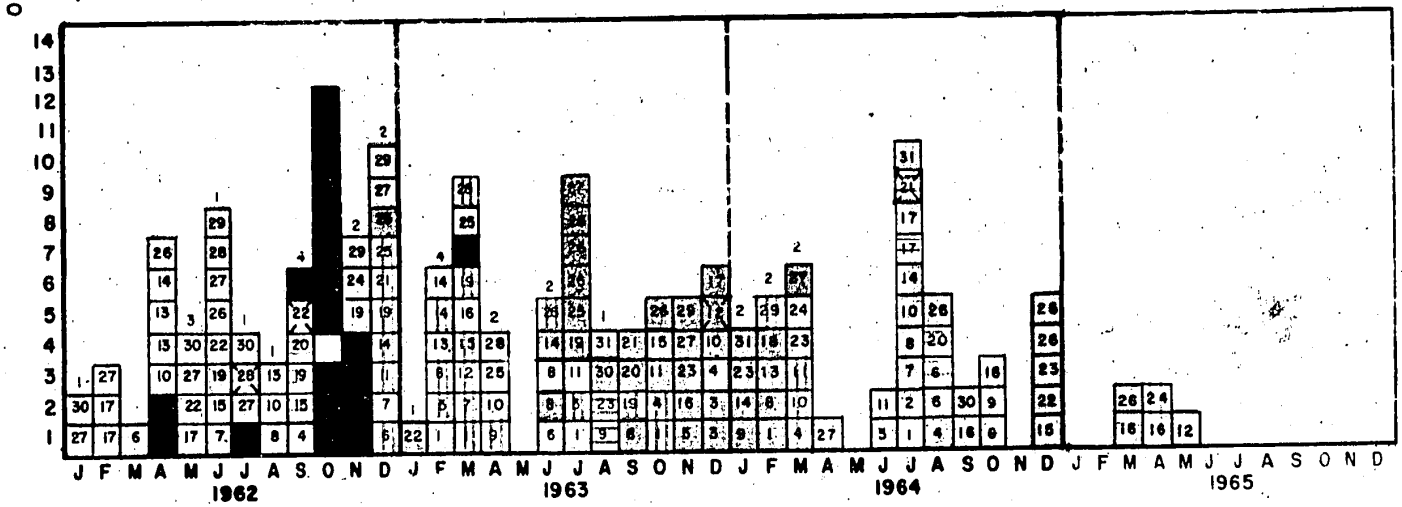
1020 NM (SS-4) MISSILE ACTIVITY



R & D ____ 62 SUC. 2 FAIL. TRNG. ____ 60 SUC. 3 FAIL. FAR EAST ____ 10 SUC. 1 FAIL.

R/R&D ____ 176 SUC. 8 FAIL. RED. RNG. ____ 17 SUC. 1 FAIL. SSATC TGT. 32 SUC. 0 FAIL.

TOTAL ____ 357 SUC. 15 FAIL



RESEARCH & DEVELOPMENT

REDUCED RANGE

R/R&D/TRAINING

TRAINING (NO TELEMETRY)

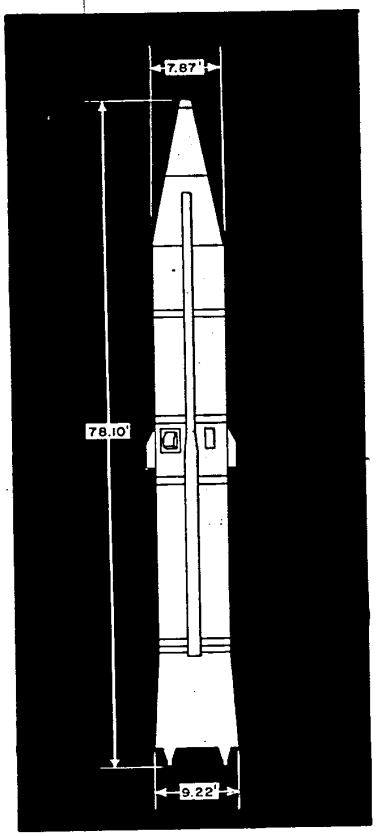
FIRED FROM MAKAT TO SARY SHAGAN AS AMM TGT

FIRED IN FAR EAST FROM SOVETSKAYA GAVAN TO KAMCHATKA

FAILURE

D-20

TOP SECRET



SYSTEM CHARACTERISTICS

U.S. DESIGNATION SS-5 (SKEAN) — SOVIET DESIGNATION UNKNOWN

STAGES — ONE

ENGINES — (4 COMB-CHAMBERS)

IOC-1961

VEHICLE WEIGHTS

AT LIFT OFF	185,400 LBS
AT BURNOUT	21,000 LBS
USABLE PROPELLANT	165,000 LBS
RE-ENTRY VEHICLE	3300 LBS

PROPULSION UNIT

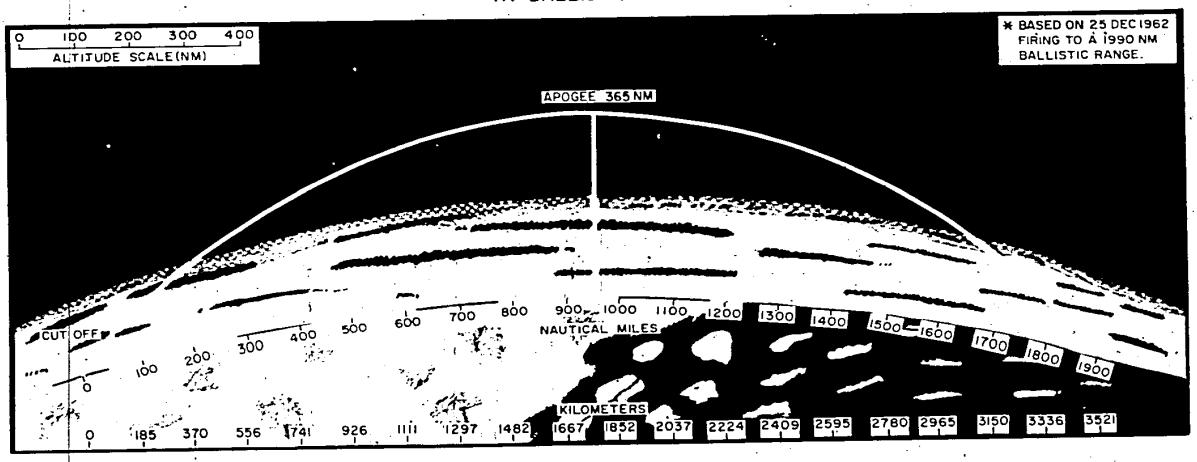
VACUUM THRUST	364,000 LBS
BURNING TIME (TOTAL)	128.8 SEC
BURNING TIME (EFFECTIVE)	125.3 SEC
DURATION OF REDUCED THRUST (VERNIER) PERIOD	10 SEC

PROPELLANT

MIXTURE RATIO	1.23:1 (VOL)
MASS RATIO	8.91
SPECIFIC IMPULSE (VAC)	277 ± 10
PROPELLANT FLOW RATE	1314 LBS/SEC
TYPE	IRFNA/AMINE (UDMH)

TRAJECTORY DATA*

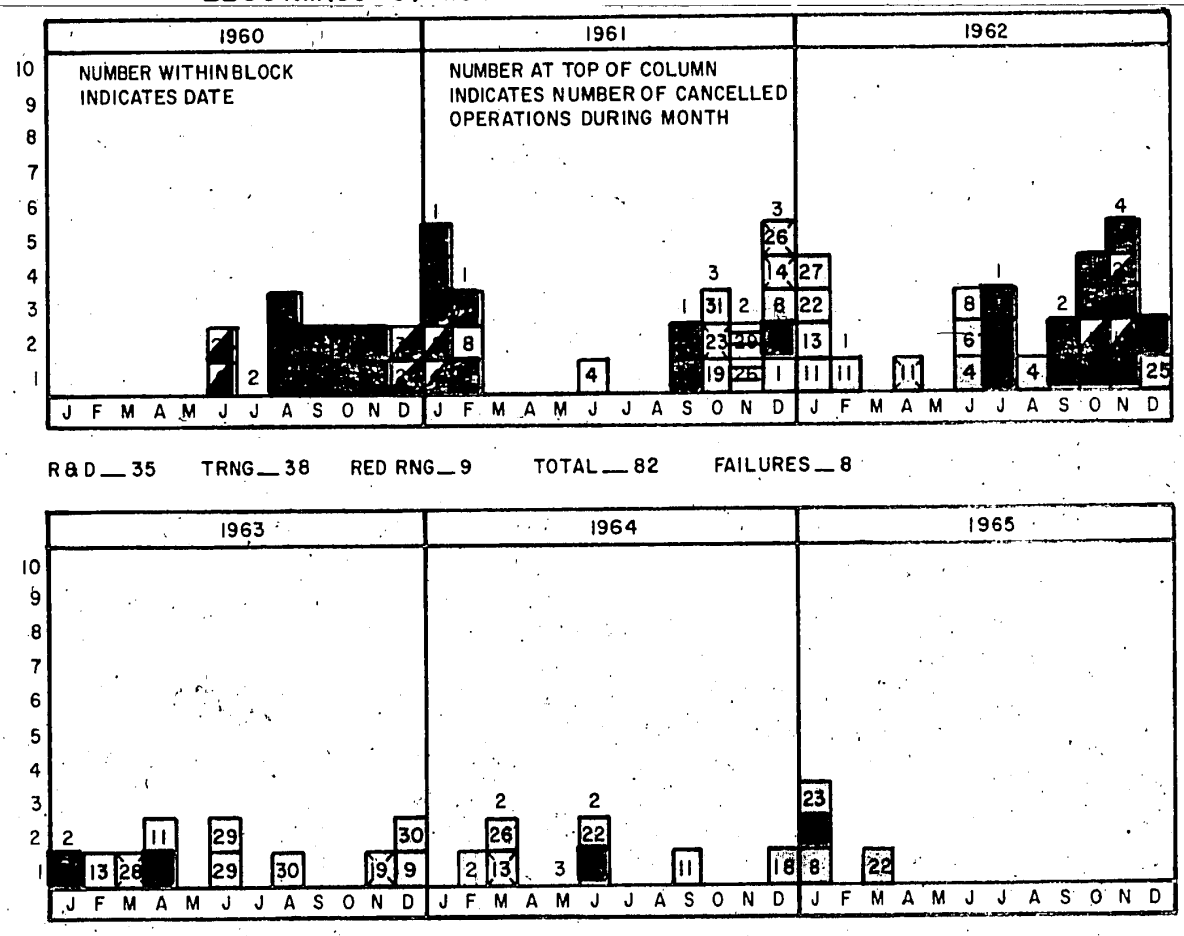
CEP	1 NM
TOTAL FLIGHT TIME	1048 SECS
BURNOUT VELOCITY	16,470 FT/SEC
BURNOUT ANGLE	32.4°
MAXIMUM ACCELERATION	12 G'S
RANGE	1920 NM (NRE)
MAXIMUM SYSTEM RANGE	2200 NM (NRE)
GUIDANCE TECHNIQUE	ALL INERTIAL
RV BALLISTIC CO-EFFICIENT	1200 ± 100



(S) SS-5 System Characteristics (U)

TOP SECRET

2200 NM (SS-5) MISSILE ACTIVITY



R&D — 35 TRNG — 38 RED RNG — 9 TOTAL — 82 FAILURES — 8

R&D (FULL TELEMETRY)

REDUCED RANGE (FULL TELEMETRY)

EXTENDED RANGE (2500NM) (FULL TELEMETRY)

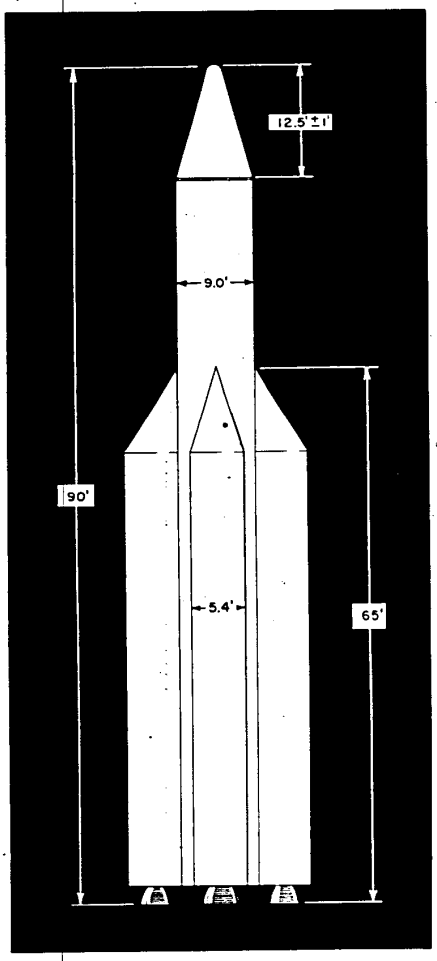
TRAINING/PRODUCTION LINE TESTS (REDUCED TELEMETRY)

TRAINING (NO TELEMETRY)

FAILURES

D-22

TOP SECRET



SYSTEM CHARACTERISTICS*

U.S. DESIGNATION SS-6 **SOVIET DESIGNATION UNKNOWN**

CONFIGURATION
PARALLEL

STAGES
ONE AND ONE HALF

ENGINES
4 BOOSTERS
1 SUSTAINER
4 VERNIER

WEIGHT

AT LIFT OFF	530,000 LBS.
AT BOOSTER BURNOUT	175,000 LBS.
AT SUSTAINER BURNOUT	23,000 LBS.

THRUST

AT LIFT OFF	895,000 LBS. (VACUUM)
BOOSTER	710,000 LBS. (VACUUM)
SUSTAINER (MAIN ENGINE)	155,000 LBS. (VACUUM)
VERNIERS	30,000 LBS. (VACUUM)

BURNING TIME

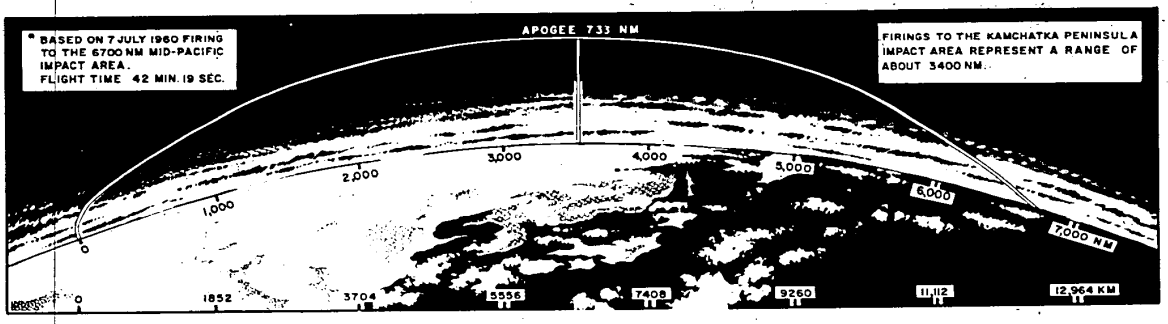
TOTAL	312 SEC.
BOOSTER	118 SEC.
SUSTAINER	302 SEC.
VERNIER	312 SEC.

PROPULSION

FUEL	UDMH/HYDRAZINE
OXIDIZER	LIQUID OXYGEN
ISP VACUUM (SUSTAINER)	315
ISP VACUUM (BOOSTER)	285

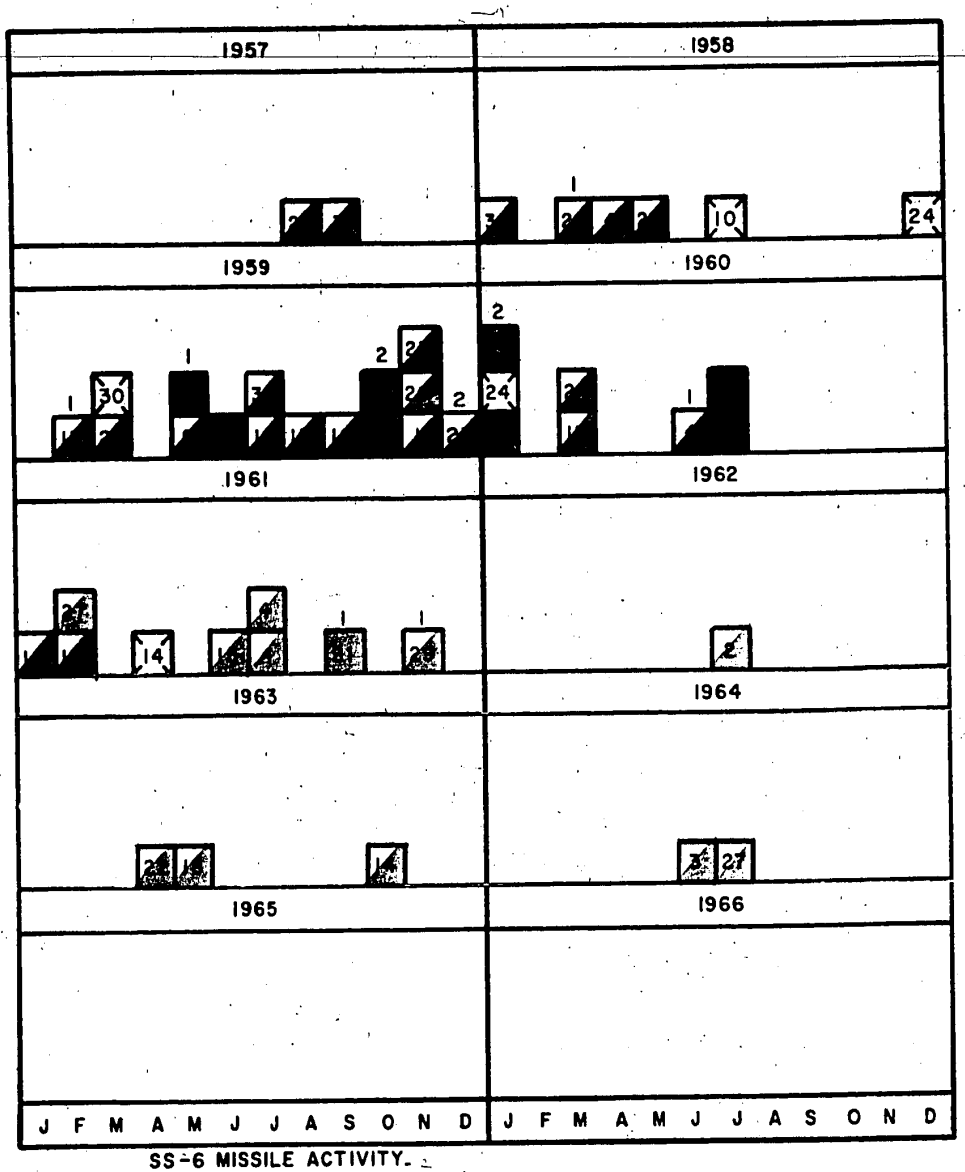
RE-ENTRY VEHICLE

RE-ENTRY VEHICLE WEIGHT	9,000 LBS.
WARHEAD WEIGHT	6,000 LBS.
BALLISTIC COEFFICIENT	1,200 ± 200 LBS/FT²
RE-ENTRY VELOCITY	23,790 FPS AT 300 K FT.



(S) SS-6 System Characteristics (U)

TOP SECRET



SS-6 MISSILE ACTIVITY

D-24

R&D EXTENDED RANGE

R&D TO KAMCHATKA

OPR-TRAINING EXTENDED RANGE

OPR-TRNG TO KAMCHATKA

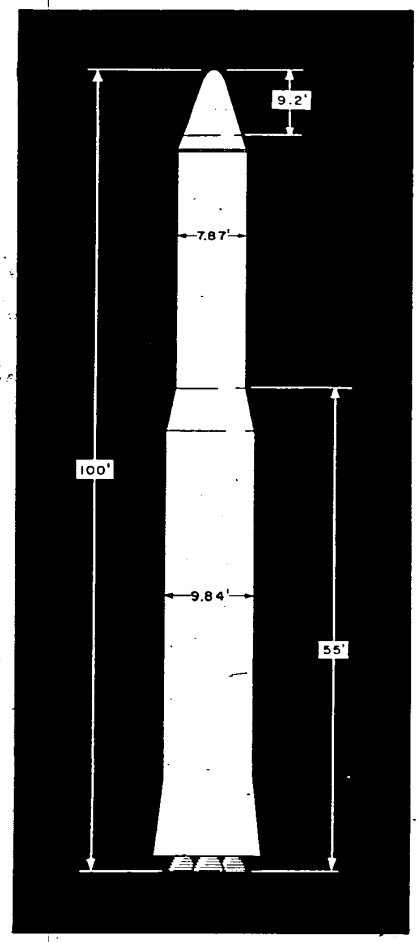
FAILURE

R & D	30
OPR-TRNG	12
FAILURES	5
TOTAL FIRINGS	47
CANCELLATIONS	12

NUMBER AT TOP OF COLUMN INDICATES NUMBER OF CANCELLED OPERATIONS DURING MONTH

NUMBER INSIDE BLOCK INDICATES DATE

TOP SECRET



SYSTEM CHARACTERISTICS*

U.S. DESIGNATION SS-7 SOVIET DESIGNATION UNKNOWN

CONFIGURATION
TANDEM

STAGES
TWO

ENGINES
3 FIRST STAGE
1 SECOND STAGE
4 VERNIERS PER STAGE

WEIGHT

AT LIFT-OFF	254,000 LBS
AT FIRST STAGE BURNOUT	90,000 LBS
AT SECOND STAGE BURNOUT	10,900 LBS

THRUST

FIRST STAGE	523,000 LBS (VACUUM)
SECOND STAGE (MAIN ENGINE)	154,500 LBS (VACUUM)
VERNIERS (SECOND STAGE)	12,000 LBS (VACUUM)

BURNING TIME

TOTAL (FIVE SECOND COAST PERIOD AT STAGING)	212.5 SEC
FIRST STAGE	85.0 SEC
SECOND STAGE	115 SEC
VERNIER SOLO (SECOND STAGE)	7.5 SEC

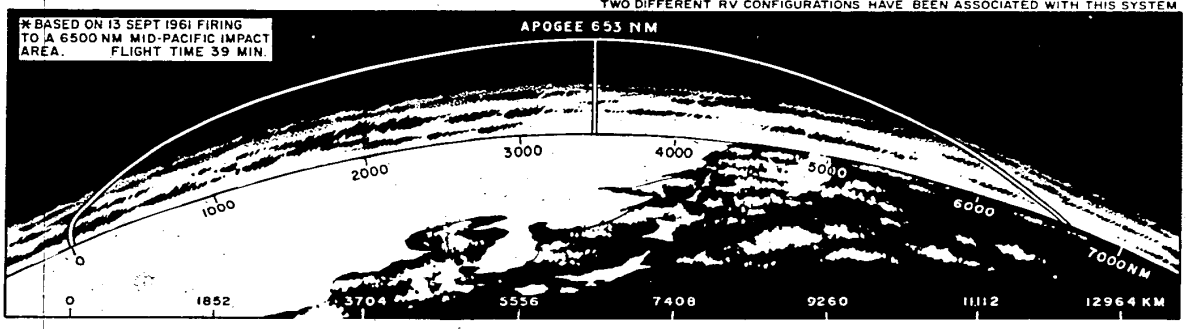
PROPULSION

FUEL	AMINE(UDMH)
OXIDIZER	IRFNA BASE
ISP VACUUM (2ND STAGE)	290
ISP VACUUM (1ST STAGE)	273

RE-ENTRY VEHICLE

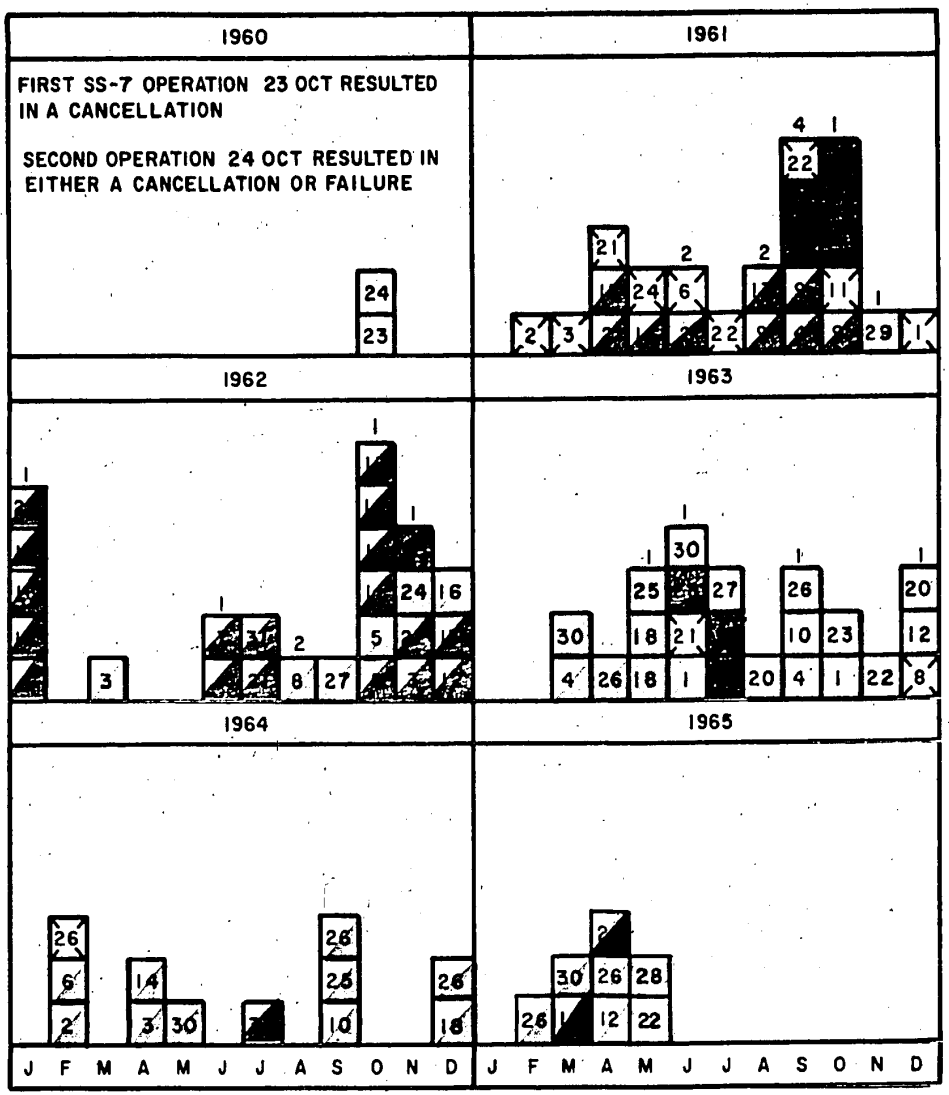
RE-ENTRY VEHICLE WEIGHT	3300 LBS
WARHEAD WEIGHT	2200 LBS
BALLISTIC COEFFICIENT	*1,200 ± 200 LBS/FT^2
RE-ENTRY VELOCITY	23,800 FPS AT 300 K FT.

*TWO DIFFERENT RV CONFIGURATIONS HAVE BEEN ASSOCIATED WITH THIS SYSTEM.



(S) SS-7 System Characteristics (U)

TOP SECRET



SS-7 MISSILE ACTIVITY.

D-26

R&D EXTENDED RANGE

R&D TO KAMCHATKA

OPR-TRAINING EXTENDED RANGE

OPR-TRNG TO KAMCHATKA

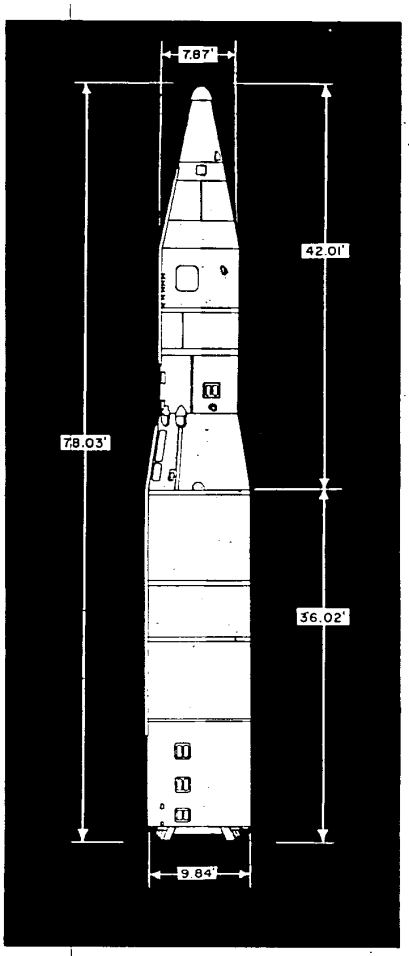
FAILURE

R&D	39
OPR-TRNG	41
FAILURES	12
TOTAL FIRING	92
CANCELLATIONS	23

NUMBER AT TOP OF COLUMN INDICATES NUMBER OF CANCELLED OPERATIONS DURING MONTH

NUMBER INSIDE BLOCK INDICATES DATE

TOP SECRET



SYSTEM CHARACTERISTICS*

U.S. DESIGNATION SS-8 (SASIN) SOVIET DESIGNATION UNKNOWN

CONFIGURATION
TANDEM

STAGES
AT LEAST TWO

ENGINES
1 FIRST STAGE
1 SECOND STAGE
AT LEAST 2 VERNIERS ON SECOND STAGE

WEIGHT

AT LIFT-OFF	171,500 LBS
AT FIRST STAGE BURNOUT	57,600 LBS
AT SECOND STAGE BURNOUT	* 9,770 LBS
SEPARATED MASS WEIGHT	1,225 LBS

* DOES NOT INCLUDE MASS EJECTED ON SHORT RANGE FIRINGS

THRUST

FIRST STAGE	343,800 LBS (VACUUM)
SECOND STAGE	74,750 LBS (VACUUM)

BURNING TIME

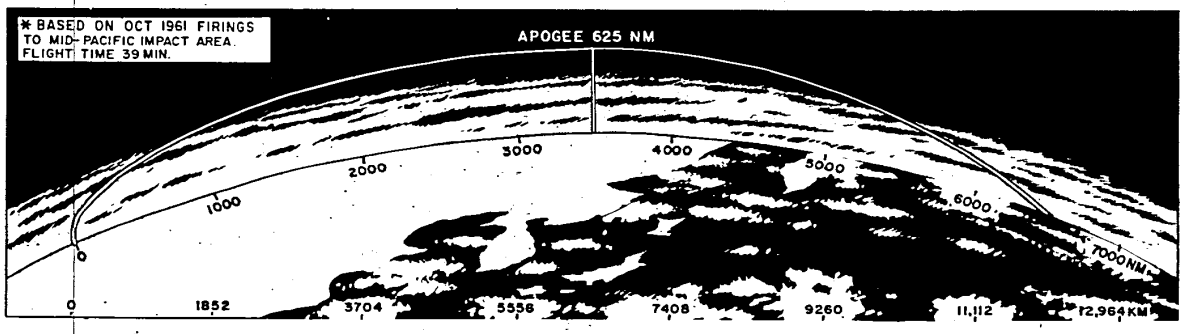
TOTAL	273 SEC
FIRST STAGE	106 (EFF) SEC
SECOND STAGE	160 (EFF) SEC
VERNIERS	7 SEC

PROPULSION

FUEL	UDMH/HYDRAZINE (50/50)
OXIDIZER	LOX
ISP VACUUM (2ND STAGE)	327 ± 3 SEC

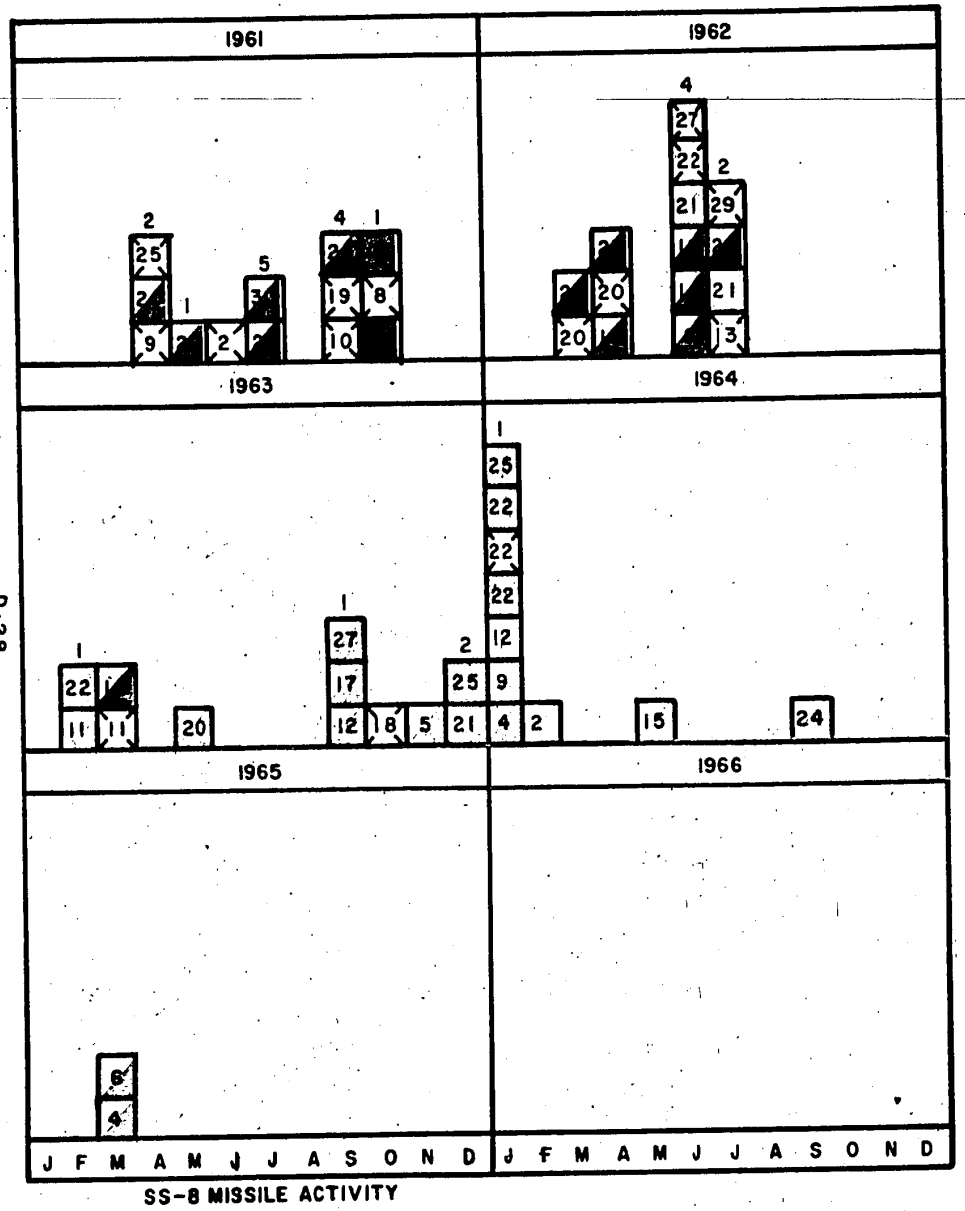
RE-ENTRY VEHICLE

RE-ENTRY VEHICLE WEIGHT	3000 LBS
WARHEAD WEIGHT	2200 LBS
BALLISTIC COEFFICIENT	1020 LBS/FT^2
RE-ENTRY VELOCITY	23,800 FPS AT 300 K FT



(S) SS-8 System Characteristics (U)

TOP SECRET



SS-8 MISSILE ACTIVITY

D-28

R&D EXTENDED RANGE

R&D TO KAMCHATKA

OPR-TRAINING EXTENDED RANGE

OPR-TRNG TO KAMCHATKA

FAILURE

R & D	15
OPR-TRNG	22
FAILURE	15
TOTAL FIRINGS	52
CANCELLATIONS	24

NUMBER AT TOP OF COLUMN INDICATES NUMBER OF CANCELLED OPERATIONS DURING MONTH

NUMBER INSIDE BLOCK INDICATES DATE

TOP SECRET

SS-9

A DETAILED ANALYSIS OF THE SS-9 SYSTEM MUST BE MADE BEFORE ITS PHYSICAL CHARACTERISTICS CAN BE ENUMERATED.

IT IS BELIEVED THAT THE SS-9 WAS DESIGNED BY THE SAME GROUP THAT DESIGNED THE SS-5 AND SS-7. SOME CHARACTERISTICS THAT HAVE BEEN DERIVED FROM TELEMETRY ARE:

THE MISSILE IS A TWO-STAGE SYSTEM THAT EMPLOYS STORABLE PROPELLANTS.

FIRST STAGE

FIRST STAGE BURNING TIME (DETERMINED FROM THE FIRING OF 5 AUGUST 1964) IS 116.5 SECONDS.

SECOND STAGE

THE SECOND STAGE CONTAINS ONE MAIN ENGINE AND FOUR VERNIER ENGINES. THE SECOND STAGE DIAMETER IS PROBABLY GREATER THAN THAT OF THE SS-7 SECOND STAGE.

MECO	267.5 SECONDS
VECO	276.2 SECONDS
RV SEPARATION	276.2 SECONDS
GUIDANCE	RADIO-INERTIAL
OXIDIZER-TO-FUEL VOL. RATIO	1.41:1
I_{sp} (VAC) FOR SECOND STAGE	315 SECONDS
RE-ENTRY VEHICLE WEIGHT	PROBABLY GREATER THAN SS-7RV.

SS—9 LAUNCH ACTIVITY

DATE AND Z TIME OF LAUNCH	RESULTS TOTAL	FIRST CNTDWN ANNC	COMMUNICATIONS GROUPS	TIMING SIGNAL DATA: TYPE	SIGNAL	DASHES BEGAN	PULSE TRAIN	TELEMETRY DETAILS: EXTERNALS	FIRST HEARD	LAST HEARD	E_1	E_2	E_3	DACS AT E_1 (CPS)	$\Delta/A-E_1$	FLIM FLAM TRAJECTORY: LAUNCH POINT	IMPACT POINT	FLIGHT TIME	RANGE (NM)	ALTITUDE AT APOGEE (NM)	VELOCITY AT BURNOUT (FPS)	RADINT TIMES (SEC) AND RANGE (NM)	REMARKS
13 Aug 1963 0459:47	S 1/1	R-1 hr TT 0359	C08 C09 C10 C12 C51 C58 C59	E	KLY	-	(0519:15) 0524:34	61/48 66/24 76/24 2800/ 24	(0504) (0504) (0504) (0513)	(0522) (0523) (0523) (0522)						45°26.8'N 63°09.9'E	57°22.4'N 161°46.0'E		1265.41	342.5.1	406.6	17,100	"X" plus 1121- 1253 ------- 1342.8- 935.8	Although not confirmed, available evidence indicates that this operation and the one on 30 August are part of the SS-9 program. Preliminary analysis indicates that one object of the firing was intensive re-entry vehicle testing.
30 Aug 1963 0630:26	S 2/2	R-30 min KLY 0329	C08 C09 C10 C12 C51 C58 C59	E	TT KLY	- -	0630:26 0648:00 0655:20	61/48 66/24 76/24 2800/ 24/ bcn	0633:16 0633:00 0635:41 0639:03	0653:04 0635:09 0653:52 0653:10						45°25.0'N 63°13.8'E	57°23.3'N 161°46.3'E		1263.8	342.4	407.29	17,114	"X" plus 1163- 1.38 ------- 1262.2- 708.6	This operation appears similar to that of 13 August.
3 Dec 1963 0800:29	S 3/3	R-30 min TT 0732	C08 C09 C12 C51 C59	E	TT KLY	0759:04	0800:24 0808:20 0817:01 0827:25	61/48 66/24 71/48 76/Unk 132/ Unk 2800/ bcn	0805:00 0805:05 0805:05 Unk Unk 0807:12	0806:22 0824:58 0805:56 0825 04	246.1	254.8	254.8			46°05.5'N 63°46.3'E	57°22'N 161°43.7'E	1337.57	3377.6	447.81	16,052	"X" plus 1127- 1455 ------- 1635.5- 664.6	
16 Jan 1964 0428:58	S 4/4	R-30 min KLY 0400	C07 C08 C09 C10 C51 C58 C59 C60	E	TT KLY	0427:58	0428:58 0436 0447 0502	61/48 66/24 71/48 76/24 132/20 142/20 2800/ bcn				254.6	254.7			45°52.9'N 63°47.9'E	57°20.9'N 161°44.9'E	1340.12	3387.6	490.24	16,048	"X" plus 1138- 1530 ------- 1614.6- 474.3	
19 Feb 1964 1515:07	S 5/5	R-1 hr KLY 1421	C07 C08 C09 C10 C12 C51 C58 C59 C60	E	TT KLY	1514:01	1515:07 1521:12 1535:07 1542:14	61/48 66/24 71/48 76/24 130/24 142/20 2800/ bcn	1519:13 1519:15 1519:13 1519:00 1519:00 1519:26 1534:05	1523:15 1539:30 1523:15 1539:30 1523:36 1523:30 1539:30						45°51.5'N 63°54.9'E	57°21.0'N 161°43.9'E	1340.59	3385.1	489.17	16,053	"X" plus 1123- 1453 ------- 1647.2- 669.9	
27 Feb 1964 0230:28	F 6/1	R-15 min KLY 0210	C08 C09 C10 C51 C58 C59 C60	E	TT	0229:23	0230:28																FLIM FLAM indicated intent to track. FLIM FLAM, telemetry, [redacted] negative, Timing signal and acoustic indicate launch occurred. Missile probably failed early in flight. First failure in the SS-9 program.
23 May 1964 0459:50	S 7/6	R-30 min KLY 0433	C08 C09 C10 C14 C51 C58 C59 C60	E	TT	Unk	0517:18 0526:03	61/48 66/24 71/24 76/24 2800/ bcn	0501:14 0501:16 0502:21 0503:52 0513:00	0504:56 0523:47 0509:03 0523:47 0523:46		246.91	256.4			46°07'N 64°08'E	57°50'N 160°26'E	1307.40	3313.8	470.01	16,090	"X" plus 1202- 1438 ------- 1370- 660	
30 May 1964 0230:30	S 8/7	R-30 min KLY 0203	C08 C09 C10 C51 C58 C59 C60	E	KLY	Unk	0246:28 0256:48	61/48 66/24 71/48 76/24 2800/ bcn	0233:21 0233:21 0233:32 0233:41 0236:16	0235:57 0254:47 0235:57 0254:47 0254:52	255.7	260.1	261.9	4.6	.024	46°17'N 63°59'E	57°22'N 161°40'E	1312.9	3310.4	466.8	16,245	"X" plus 1167- 1439 ------- 1480- 659	
24 Jun 1964 0442:27	S 9/8	R-30 min KLY 0415	C07 C08 C09 C10 C14 C51 C58 C59 C60	E	TT	0440:59	0442:27	61/48 66/24 76/24 76/48 2800/ bcn	0445.58 0446:48 0446:48 0455.33 0449:15	0447.52 0507.49 0507.49 0505:37 0506:44	254	260.4				46°07'N 63°57'E	57°16'N 161°50'E	1320.76	3375.3	471.68	16,225	"X" plus 1314- 1462 ------- 1057- 589	
30 Jun 1964 2230:04	S 10/9	R-1 hr KLY 2133	C07 C08 C09 C10 C51 C58 C59 C60	E	KLY	(2248:53)	2249 00 2254 05	61/48 66/24 71/48 76/24 132/20 142/20 2800/ bcn	2235:00 2234:20 2234 20 2234 10 2233 50 2233:50 2248:20	2235:40 2254:24 2236:30 2254:24 2237:30 2235:00 2254:24	254.2	260.3				46°14'N 63°51'E	57°21'N 161°45'E	1317.88	3366.7	— 471.13	16,216	"X" plus 1141- 1459 ------- 1575- 609	
05 Aug 1964 0200:29	S 11/10	R-2 hrs TT 0008	C08 C09 C10 C51 C58 C59 C60 SMRLS	E	TT	0159:00	0200:29	61/48 66/24 66/48 66/Unk 71/48 76/24 76/Unk 165/48 2800/ bcn	0205:25 0205:44 0205 04 0240:34 0205:45 0205:29 0236:30 0202 45 0210 50	0207:20 0236:30 0207 50 0245.18 0205 50 0238:10 0245 18 0203 48 0236 40	265.8	274.5	274.5	0.5	.035	46°01'N 63°53'E	56°00'N 165°30'E	2401.0	6999.9	806.38	18,436	"X" plus 914- 918 ------- 1940- 1930	First extended range firing. Greatest range of any ICBM fired to date. Visually observed in impact area. Continuation of R&D testing.

E_1 - Main Engine Cutoff, E_2 - Vernier Engine Cutoff, E_3 - Separation

SS—9 LAUNCH ACTIVITY

DATE AND Z TIME OF LAUNCH	RESULTS TOTAL	FIRST CNTDWN ANNC	COMMUNICATIONS GROUPS	TIMING SIGNAL DATA: TYPE	SIGNAL	DASHES BEGAN	PULSE TRAIN	TELEMETRY DETAILS: EXTERNALS	FIRST HEARD	LAST HEARD	E_1	E_2	E_3	(ACT. E_3)	E_2–E_1	FLIM FLAM TRAJECTORY: LAUNCH POINT	IMPACT POINT	FLIGHT TIME	RANGE (NM)	ALTITUDE (NM) APOGEE	VELOCITY AT APOGEE (FPS)	RADINT TIME (SEC) AND RANGE (NM)	REMARKS
11 Aug 1964 0200:05	P 12/2	R-2 hrs TT 0010	C08 C09 C10 C51 C58 C59 C60 SMRIS		*See Remark																		Timing signal on the air for about 7 minutes. Negative FLIM FLAM, telemetry and [redacted] indicate failure. Probably programmed as an extended range firing.
09 Sep 1964 0213:03	S 13/11	R-30 min KLY 0144	C08 C09 C10 C51 C58 C60 SMRIS					61/48 66/24 71/48 76/24 2800/ 24 61/36 2720/ bcn	0218:29 0217:47 0218:29 0218:25 0229:21	0247:22 0257:50 0247:22 0257:50 0246:31		274.4	271.5				04°22'S 165°42'W	12461.12	6992.1	807.54	18,429	"X" plus 850-907 ---- 2070-1927	Visual sighting of re-entry. Similar to 5 Aug operation.
25 Sep 1964 0403:33	S 14/12	R-1 hr TT 0306	C08 C09 C10 C15 C16 C51 C60	E	TT	0401:14	0403:33	61/Unk 71/Unk	0408:25	0409:25	1258.9	267.6	267.7		6.2							"X" plus 1285-1549 ---- 1266-1080	The lack of FLIM FLAM tracking, and the reduced telemetry suggests an advanced R&D firing. Visual sighting of re-entry. Probably part of a demonstration.
10 Oct 1964 (0200)	S 15/13	R-10 min KLY 0152	C08 C09 C10 C15 C51 C58 C59 C60					61/48 71/48 76/24 66/24 142/ 20 2805/ 24 2809/ bcn 71/36 132/ 20	0204:43 0204:25 0204:38 0204:00 0204:52 0206:00 0217:43	0205:31 0205:32 0224:29 0224:29 0205:00 0209:06 0224:26	266	274.5	274.5			46°06'N 63°56'E	57°21'N 161°42'E	1315.08	0370.3	1467.08	16,266	"X" plus 1168-1446 ---- 1510-665	Extensive use of telemetry indicates vehicle still in R&D phase.
29 Oct 1964 (0159)	S 16/14	NONE NOTED	C08 C09 C10 C15 C51 C58 C59 C60		TT			61/48 66/24 71/48 76/24 2805/ 24/ bcn	0204:40 0204:40 0204:40 0204:50 0217:24	0206:28 0224:27 0205:28 0224:21 0224:27						46°07'N 63°50'E	57°20'N 161°46'E	1318.05	3376.4	468.76	16,261	"X" plus 1389-1501 ---- 1012-622	Aerodynamic fairings observed on radar. Continuation of R&D firings.
15 Dec 1964 (0200)	S 17/15	H-30 min DHT KLK	C08 C09 C10 C51 C58 C59 C60					61/48 [illegible] 24/ bcn	0005:16 [illegible]	0006:08 [illegible]						[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	"X" plus 1205-1401 ---- 1439-661	[redacted] indicated two delays in countdown. Firing probably scheduled for 1800 and 2300 on 14 December and 2300 on 15 December.
13 Jan 1965 (0502)	P 18/3	R-2 hrs TT 0311Z	C08 C09 C10 C15 C51 C58 C59 C60 SMRIS																				Timing signal indicated a launch at 0502Z. Negative [redacted] and visual sighting indicate failure. This was probably an attempt to fire an SS-9 to the mid-Pacific Impact Area.
30 Jan 1965 (0804)	S 19/16	R-2 hrs 0500Z *See Remarks	C08 C09 C10 C51 C54 C58 C59 C60 SMRIS	Post launch only	TT			61/24 66/24 66.3/ Unk 71/48 76/24 2800/ bcn	0807:55 0808:18 0815:30 0807:55 0808:01 0822:28	0810:27 0849:38 0840:35 0800:09 0809:17 0848:30						40°16'N 64°03'E	01°04'N 164°05'W	2458.3	6994.9	805.9	18,462	"X" plus 894-962 ---- 2058-1908	The missile was tracked by radar and visually observed in the impact area. Delays were encountered in the countdown.
27 Apr 1965 (0500)	S 20/17							61/48 76/24 132/20 142/ Unk	0504:25 0504:18 0504:41 0504:40	0506:53 0524:11 0504:54 0504:54											"X" plus 1118-1447 ---- 1616-733	Fired to Kamchatka impact area. Lack of FLIM FLAM probably due to beacon failure. Continuation of R&D testing.
18 May 1965 (0500Z)	S 21/18		T04 T05 T06 T07 T08 T09 T30 T31 T32 T33 60T					182/48 61/48 71/48 66/24 76/24 132/20 142/20 2800/ 24/bcn (71/24)	0501:54 0501:46 0501:45 0501:48 0501:48 0504:37 0504:44 0517:47 0523:35	0502:23 0505:42 0505:29 0525:10 0525:10 0504:54 0504:54 0524:10 0525:10											"X" plus 1329-1436 ---- 989-655	Fired to the Kamchatka impact area. FLIM FLAM station 9 action by no tracking data passed. Probably continuation of R&D testing.

E_1 - Main Engine Cutoff; E_2 - Vernier Engine Cutoff; E_3 - Separation

SS—10 LAUNCH ACTIVITY

DATE AND Z TIME OF LAUNCH	RESU-LTS TOTAL	FIRST CNTDWN ANNC	COMMUNI-CATIONS GROUPS	TIMING SIGNAL DATA				TELEMETRY DETAILS								FLIM FLAM TRAJECTORY						RADINT TIME (SEC) AND RANGE (NM)	REMARKS
				TYPE	SIGNAL	DASHES BEGAN	PULSE TRAIN	EXTERNALS	FIRST HEARD	LAST HEARD	E_1	E_2	E_3	DACR AT E_1 (CPS)	d/a-E_1	LAUNCH POINT	IMPACT POINT	FLIGHT TIME	RANGE (NM)	ALTITUDE AT APOGEE (NM)	VELOCITY AT APOGEE (FPS)		
11 Apr 1964 0705:54	F 1/1	R-30 min KLY 0638	C08 C09 C10 C51 C58 C59 C60	E	TT KLY	- -	0710:00-0715:20 0723:56-0733:03	66/24 71/48	0709:04 0709:04	0710:19 0710:28	206.0		223.2										Although the Khutor FLIM FLAM site indicated a readiness to track, no valid data were passed. The lack of FLIM FLAM and negative [redacted] indicate failure. The internal features of telemetry are not similar to those of any other vehicles.
15 May 1964 0656:00	S 2/1	R-30 KLY 0634	C08 C09 C10 C14 C51 C58 C59 C60	E	TT KLY	- -	0656:00 0711:00 0720:10	66/24 66/Unk 71/48 76/48 136/Unk 2800/bcn	0658:14 0710:00 0659:00 0658:21 0659:20 0714:20	0718:35 0710:15 0700:49 0659:29 0700:49 0718:35	235.2	249.8	248.3		.024	46°12'N 63°14'E	57°19'N 161°48'E	1220.48	3390.4	371.81	17,499	"X" plus 1158-1526 ------- 1396-275	Additional objects tracked by radar to within 100 nm SW of Attu.
30 May 1964 0402:51	S 3/2	R-30 min KLY 0336	C08 C09 C10 C51 C58 C59 C60	E	TT KLY	0401:40 -	0402:51 0419:59 0450:43	66/24 71/48 2800/24/bcn	0420:51 0406:54 0420:47	0424:40 0407:20 0425:05						46°14'N 63°08'E	57°22'N 161°41'E	1224.11	3390.0	375.46	17,450	"X" plus 1146-1290 ------- 1338-771	Additional objects tracked by radar.
17 Jun 1964 0400:31	S 4/3	R-15 min KLY 0346	C07 C08 C09 C10 C51 C58 C59 C60	E	TT KLY	- -	0401:00 0407:56 0419:44 0425:05	66/Unk 66/24 71/48 2800/bcn	0404:18 0418:34 0404:35 0418:35	0405:54 0422:49 0405:10 0422:49	229	242.2				46°09'N 63°09'E	57°18'N 161°48'E	1224.26	3404.2	374.76	17,470	"X" plus 1096-1318 ------- 1414-675	One additional object tracked by radar at ranges of 375 - 345 nm.
01 Aug 1964 0554:49	S 5/4	NONE NOTED	C08 C09 C10 C51 C58 C59 C60	E	TT	0549:01	0554:49	66/24 71/48 76/48 136/20 2800/24	0549:49 0549:51 0539:59 - 0612:55	0616:55 0555:14 0556:43 - 0616:55	222.9	236.5				46°14'N 63°00'E	57°19'N 161°51'E	1219.83	3396.0	370.21	17,535	"X" plus 1157-1284 ------- 1177-765	One additional object tracked by radar from 360 nm to 350 nm.
24 Sep 1964 0556:15	S 6/5	R-30 min TT KLY	C08 C09 C10 C15 C51 C54 C58 C59 C60					66/24 71/48 136/20 2800/24/bcn	0600:18 0600:10 0558:54 0614:10	0618:40 0600:45 0600:45 0618:32						46°15'N 63°12'E	57°19'N 161°48'E	1218.93	3388.6	370.68	17,511	"X" plus 1185-1277 ------- 1070-775	Probably part of demonstration.
02 Oct 1964 0335:14	S 7/6	R-15 min KLY 0214	C08 C09 C10 C51 C58 C59 C60	E	TT	0334:27	0335:14	66/24 71/48 2810/bcn	0352:58 0339:20 0354:55	0357:58 0339:49 0357:24						46°36'N 63°06'E	57°18'N 161°51'E	1212.83	3374.0	367.68	17,519	"X" plus 1169-1323 ------- 1127-475	Probably continuation of R&D firings.
20 Oct 1964 (0229)	S 8/7	R-2 hrs TT	C08 C09 C10 C51 C58 C59 C60 SMRLS					66/24 71/48 76/48 2602/24/bcn	0245:25 0231:35 0231:39 0240:23	0255:30 0236:46 0232:14 0259:09	244.0	254.5	254.5			46°10'N 63°02'E	00°51'N 172°23'W	2142.35	6461.5	610.34	19,292	"X" plus 1015-1043 ------- 1780-1715	First extended range firing of SS-10. Launched to northern-most impact area. Visual sighting in the impact area.

E_1 - Main Engine Cutoff; E_2 - Vernier Engine Cutoff; E_3 - Separation

SS-10

ALTHOUGH AVAILABLE INFORMATION IS TOO LIMITED TO PERMIT AN ESTIMATE OF THE SS-10 SIZE, THE FOLLOWING CONCLUSIONS HAVE BEEN DRAWN:

THE SS-10 WAS DESIGNED BY THE SAME TEAM THAT DESIGNED THE SS-6 AND SS-8.

GUIDANCE IS RADIO-INERTIAL.

RV SEPARATION IS DELAYED 0.5 SECONDS AFTER VECO. THE FINAL STAGE IS PROBABLY RETARDED.

PROPELLANTS ARE LIKELY CRYOGENIC DUE TO THE TYPE OF PROPELLANT LEVEL SENSORS USED.

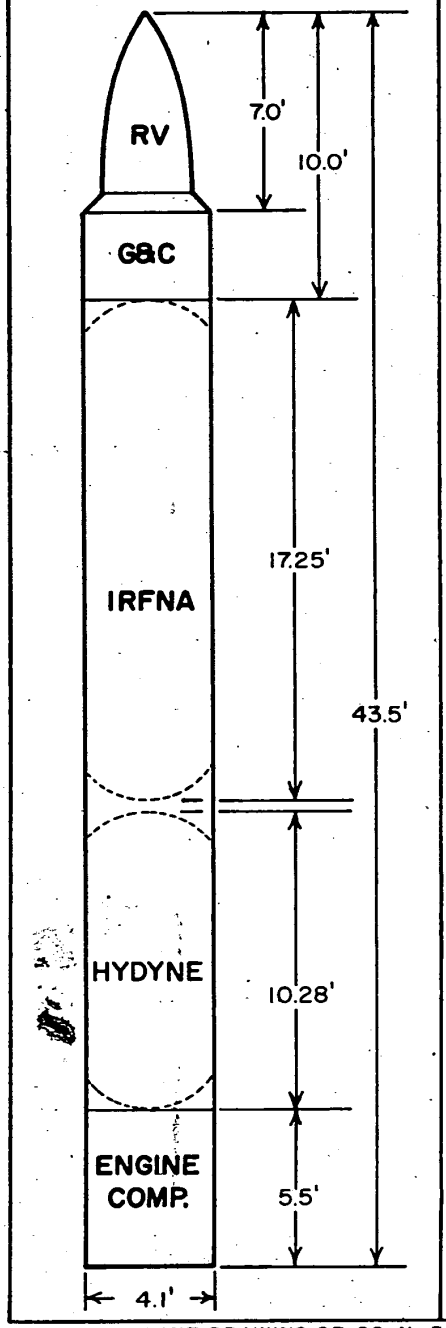
PERFORMANCE STUDIES CONSTRAINED BY BURNOUT CONDITION AND MASS FRACTION YIELD A VALUE OF SPECIFIC IMPULSE BETWEEN 300 AND 340 SECONDS.

ON THE BASIS OF STAGE BURNING TIMES, THE VEHICLE IS EITHER:

A. UNDERSTAGED.

B. INCORPORATES MORE THAN TWO STAGES.

C. INCORPORATES A LIFTING POWERED FLIGHT TRAJECTORY.



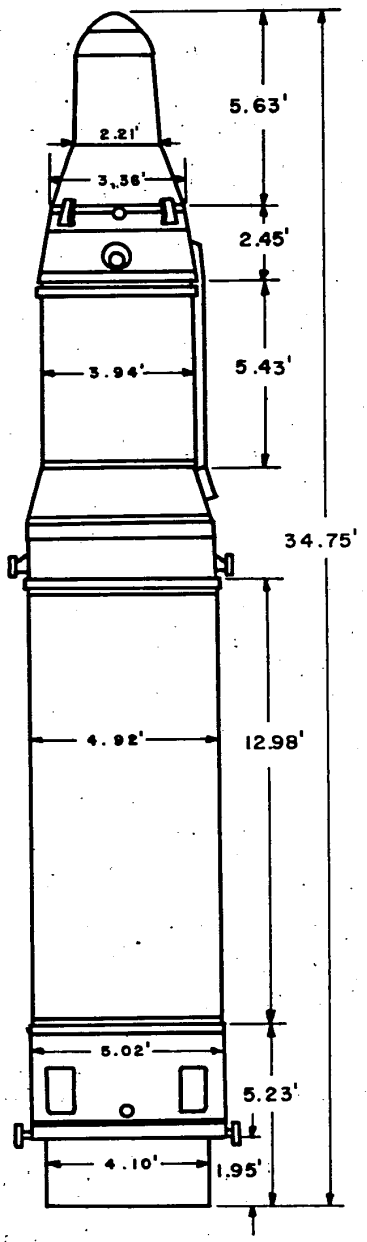
LINE DRAWING OF SS-N-5 MISSILE

SYSTEM CHARACTERISTICS

U.S. DESIGNATION SS-N-5 SOVIET DESIGNATION UNKNOWN

Stages	Engines
ONE	4 Engines with no verniers

WEIGHT	
At Liftoff	32850 lbs
At Burnout	7000 lbs
THRUST	
At Liftoff	63100 lbs
At Burnout	72000 lbs
PROPULSION	
Fuel	Amine (Hydyne)
Oxidizer	IRFNA
Ispv	273 sec
Useable Propellant	25850 lb
Burn time	98 sec
Propellant Flow Rate	264 lb/sec
Mixture Ratio (o/f) vol	1.75
Mass Ratio	4.7
RE-ENTRY VEHICLE	
Seperation	98.4 sec
Weight	1800 lb
TRAJECTORY	
Range	650 nm
Maximum Range	720 nm
Apogee	158 nm
Flight time	622 sec
Guidance	Inertial



LINE DRAWING OF SERB MISSILE.

SYSTEM CHARACTERISTICS

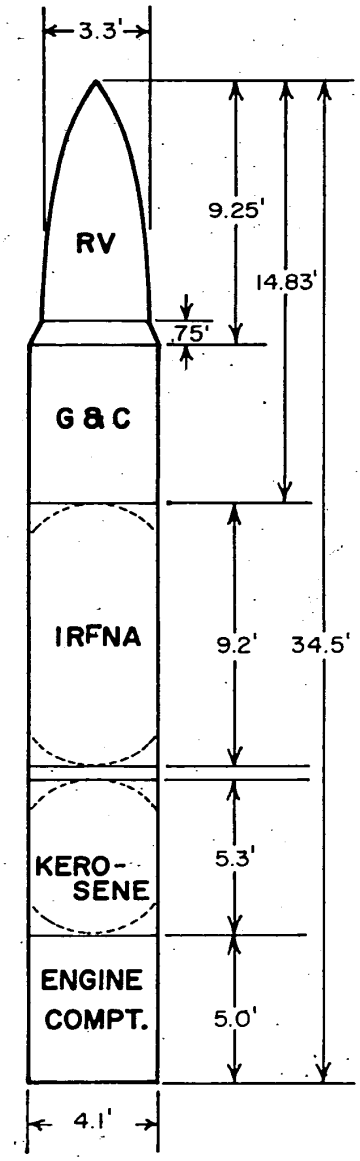
U.S. DESIGNATION SERB SOVIET DESIGNATION UNKNOWN

Configuration	Stages
TANDEM	TWO

Nozzle Arrangement
4 nozzles both stages

WEIGHT	
At liftoff	37800 lb
At Burnout 1st stage	14870 lb
At ignition 2nd stage	9140 lb
At Burnout 2nd stage	3100 lb
THRUST	
First Stage(Sea Level)	87900 lb
Second Stage(Vacuum)	26160 lb
Maximum Acceleration,First Stage	5.5 g's
Maximum Acceleration,Second Stage	7.7 g's
BURNING TIME	
First Stage*	60 sec
Second Stage*	60 sec
PROPULSION	
Propellant	Solid
Specific Impulse, First Stage(Sea Level)*	230 sec
Specific Impulse, Second Stage(Vacuum)*	260 sec
Propellant Flow Rate,First Stage	382 lb/sec
Propellant Flow Rate,Second Stage	101 lb/sec
RE-ENTRY VEHICLE	
Weight	1500 lb
Range	1100 nm
Apogee	252 nm
Flight time	849 sec
Cut off angle	36 degrees

*Assumed Values



LINE DRAWING OF SS-N-4 MISSILE

SYSTEM CHARACTERISTICS

U.S. DESIGNATION SS-N-4 SOVIET DESIGNATION UNKNOWN

Stages	Engines
ONE	1 main engine 4 control engines (Control engines develop 1/3 of Thrust)

WEIGHT	
At liftoff	17600 lbs
At MECO	5175 lbs
At VECO	5020 lbs
Useable Propellant	12580 lbs
THRUST	
At liftoff	32400 lb (S/L)
Main Engine	21600 lbs (S/L)
Control Engines	10800 lbs (S/L)
At burnout	37740 lbs (V)
BURN TIME	
Main Engine	83.96 sec
Control Engines	87.25 sec
PROPULSION	
Fuel	Kerosene
Oxidizer	IRFNA
Ispv	255 sec
Propellant flow rate	148 lb/sec
Mixture Ratio(o/f) vol	1.9
Mass Ratio (MECO)	3.4
RE-ENTRY VEHICLE	
Separation	87.60 sec
Weight	2200 lb
TRAJECTORY	
Range	310 nm
Maximum Range	340 nm
Apogee	83 nm
Flight time	431 sec
Guidance	Inertial

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